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BELTZVILLE LAKE CONDITION REPORT, DAM, OUTLET WORKS AND SPILLWA--ETC(U)
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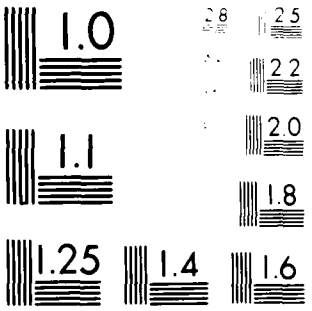

LEHIGH RIVER BASIN

POHOPOCO CREEK, PENNSYLVANIA

# BELTZVILLE LAKE

## CONDITION REPORT

## DAM, OUTLET WORKS & SPILLWAY

## PERIODIC INSPECTION REPORTS NO. 3 & NO. 4

## SEPTEMBER 1972 & AUGUST 1973



DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE - 2D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

JUNE 1974



REPORT NO: DAEN/NAP-01340/PIR0304-74/06

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# REPORT DOCUMENTATION PAGE

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AD-A112 182

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Beltzville Lake condition report, dam, outlet works & spillway, periodic inspection reports No. 3 & 4, Sept. 1972 & August 1973.

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Philadelphia, PA 19106

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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Beltzville Lake, Pa.
Dam Safety
Dam Inspection

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The third periodic inspection of Beltzville Dam was held on 14 and 15 September. Installation of two additional weirs and a study of seepage was requested. During the fourth periodic inspection on 23-24 August 1973 it was reported that weir records showed no increase in base flows thus indicating a stabilized seepage flow which is of minimal volume.

Instrumentation installed appeared to be adequately monitoring dam performance. The overall condition of the project was considered excellent.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

NADEN-TF (5 Jul 74) 1st Ind
SUBJECT: Beltzville Lake, Periodic Inspection Report Number 3 & 4

DA, North Atlantic Division, Corps of Engineers, 90 Church Street, New York, NY 10007 9 August 1974

TO: District Engineer, Philadelphia

The subject report is approved.

FOR THE DIVISION ENGINEER:

M. SCHECHET
Chief, Engineering Division

1 Incl (in dupe)
Report
wd 4 cys

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO

NAPEN-F

5 July 1974

SUBJECT: Beltzville Lake, Periodic Inspection Report Number 3 & 4.

Division Engineer, North Atlantic
ATTN: NADEN

In accordance with the instructions contained in ER 1110-2-100, "Periodic Inspection and Continuing Evaluation of Civil Works Projects", the subject report is transmitted for your review and approval.

FOR THE DISTRICT ENGINEER:

1 Incl (6 cys)

Worth D. Phillips
WORTH D. PHILLIPS
Chief, Engineering Division

Condition Report

Beltzville Lake

Pohopoco Creek, Pennsylvania

Periodic Inspection Report No. 3 & 4

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INSPECTION & ACTION SUMMARY
PERIODIC INSPECTION REPORT NO. 3 & 4

| Item | Summary of Comment(s) | Action |
|---|---|---|
| 1. Abutment & embankment junctions. | Erosion noted at downstream and upstream contacts of embankment with right abutment. Boulders placed on downstream junction during construction to reduce erosion have been only partially effective condition noted in Periodic Inspections 1,2,3 & 4. | Dam operating personnel are filling and regrading the upstream contact area to provide drainage away from riprap toe. No action has been taken or is contemplated at present for the downstream area since condition of contact area is stable. |
| 2. Sloughing or erosion of embankment slopes. | Resistance of material on downstream slopes to weathering & possible eventual clogging of horizontal drain with migrating fines was questioned during Periodic Inspection #1; minor erosion paths in downstream slope were noted during Periodic Inspection No. 2; no problems noted during Periodic Inspections 3 & 4. | Slope has been closely observed for sloughing and erosion by operating personnel. Piezometers indicate no pressure increases attributable to ineffectiveness of horizontal drain. Gradation of drain should preclude infiltration. |
| 3. Spillway - Weepholes and drainage system. | Some weepholes in spillway slab clogged with dirt and needed cleaning (Periodic Inspection No. 1); installation of screens to prevent clogging & entry of burrowing animals recommended (Periodic Inspections 1, 2 & 3). | Screens were installed following third periodic inspection. |
| 4. Outlet Works Conduit concrete surfaces and cracks. | Minor craking in transition zone, conduit and tower sections noted in Periodic Inspections 1 & 2, crack survey and updating recommended. Minor spalling noted in Periodic Inspections 2,3 & 4. | Crack survey was made following Periodic Inspection No. 1 and updated after Periodic Inspection No. 2. No further action planned at this time. |

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| 5. Seepage Condition (Embankment and/or foundation). | Small springs noted along left abutment downstream of dam (Periodic Inspection No. 2); seeps in rock cut to right of stilling basin had begun during preceding winter & continued throughout the summer, base flow of seepage along left abutment had increased during filling of the reservoir (Periodic Inspection No. 3). Installation and monitoring of weir system (Inspections 2 & 3) and seepage study (Periodic Inspection No. 3) recommended. | Weirs installed, maintained and monitored. Evaluation of seepage condition submitted (Para 8, Periodic Inspection Report No. 3 and 4). Monitoring of weirs by operating personnel will continue on current schedule. |
| 6. Outlet Works - Joints and joint material. | Leakage noted at construction joints 2+53.59 (Periodic Inspection No. 2) and 11+53.59 (Periodic Inspections 2,3 & 4). Minor spalling at construction joints noted during all inspections. Spalls appear to be result of patch failures. | Joints will be monitored by Periodic Inspection Teams for further deterioration. No further action recommended at this time. |
| 7. Outlet Works - Water passages including drains. | Replacement of missing pressure cell cover plate recommended (Periodic Inspection No. 2 & 3). | Pressure cell cover replaced in spring 1973. |
| 8. Spillway - Concrete surfaces. | Hairline cracking and poor surface appearance noted (Periodic Inspection No. 1); no changes in appearance or condition noted in Periodic Inspection Nos. 2,3 & 4 except for some new spalling in center slabs upstream of bridge piers (Periodic Inspection No. 3). | Crack survey completed following Periodic Inspection No. 2. |
| 9. Spillway - Joint displacement and joint material. | Extrusion of pre-molded joint material along the left side of the north spillway bridge pier due to closure of joint (Periodic Inspections No. 1,2,3 & 4). Joint space on right side of pier has opened to extend that [illegible] material does not cover joint (Periodic Inspection No. 4). | North bridge pier will be monumented to determine if joint action is the result of pier movement. Condition of joint material will be observed to determine need for replacement. |

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| 10. | Miscellaneous - Fencing. | Fencing located at Tower Bridge abutment, designed to prevent entrance by unauthorized personnel, is inadequate (Periodic Inspection No. 2). | Security fencing was modified to prohibit access by unauthorized personnel following Periodic Inspection No. 2. |
| 11. | Miscellaneous - Saw Mill Run erosion ditch. | A ditch running from the downstream toe to Saw Mill Run had been badly eroded. Steep banks, 20 to 25 feet high with overhanging trees, presented a safety hazard to the Public (Periodic Inspection Report No. 2 | Work on a drainage pipe commenced following Periodic Inspection No. 2 and was completed and performing satisfactorilly prior to Periodic Inspection No. 4. |
| 12. | Miscellaneous - Access Road entrance speed reduction. | Because of combination of vertical and horizontal curves on the relocated highway in the vicinity of the entrance to the public overlook area, sight distance were considered marginal. Recommendation to approach state highway officials to consider reduction of speed limit in this area of the public highway (Periodic Inspection No. 2) | No formal action taken. No complaints from public or accidents have been reported to the District. |
| 13. | Intake Tower Equipment - water quality control gates and hoists. | Gate does not close completely, having an opening of 0.4 inches in closed position (Periodic Inspection No. 3); Control gate leaks around stem seal at specific gate settings (Periodic Inspection No. 4) | Control gate can be closed manually should the need arise for complete closure-no further action contemplated. Gate stem seal leak will be studied by District personnel. |
| 14. | Intake Tower Equipment - Sluice gate and hoist. | Number 1 sluice gate had a bent stem and cracked casing and indicators were loose. (Periodic Inspection No. 3) | Stem and casing repaired; adjustments made to prevent reoccurrence. |

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| 15. | Intake Tower Equipment - Elevator | Elevator was not operational at the time of Periodic Inspection No. 3. Primary causes of problem were shorts in the power cable and corrosion of relay contacts due to high humidity in the tower. | Permanent repairs completed after Periodic Inspection No. 3. Maintenance contractor keeping elevator in working order. |
| 16. | Intake Tower Equipment - Electrical (general). | Water present in electrical condits and boxes at lower elevations. Recommended surface mounting of boxes and repair of dead portable heater socket @ El.548. (Periodic Inspection No. 3). Most work completed with exception of a few receptacles still to be reset (Periodic Inspection No. 4). | District electrician has rewired lower tower elevations and provided for drainage of water in conduits. |
| 17. | Intake Tower Equipment - Heating (general). | Providing adequate heating in lower levels of the tower recognized as a problem, study of problem and initiation of corrective measures recommended. (Periodic Inspection No. 3). | Study and corrective measures completed. |
| 18. | Spillway - Bridge guard rails. | Many nuts holding guard rail to bridge parapet were not tight against railing base. (Periodic Inspection No. 3). | Nuts tightened after Periodic Inspection No. 3). |
| 19. | Spillway - Side slopes. | Erosion noted along right side of spillway cut upstream of chute (Periodic Inspection No. 3); extent of weathering of slope questioned, comparison of present condition with photos from construction files to determine extent recommended (Periodic Inspection No. 4). | Operating personnel are correcting erosion problem by extending top of slope drainage ditch past erosion area. District will research construction files for photos and comparison with existing conditions will be made. |

| | | | |
|---|---|---|---|
| 20. | Recreation Area - Boat launching ramp. | State park managers and dam operating personnel reported a potentially dangerous situation. During first summer of operation, two cars has rolled down ramp into 10 to 15 feet of water will launching or landing boats. (Periodic Inspection No. 3). | Boat launching ramps are being swept clean of loose gravel which had apparently contributed to former problems. No further problems reported. |
| 21. | Intake Tower Equipment - Emergency engine generator. | Hydraulic starter for emergency engine generator is difficult to reprime when engine fails to start, requires 20 minutes to reprime using hand crank. | Problem will be investigated by District personnel as funds become available for the study. |
| 22. | Stilling Basin - Outlet channel side slopes. | Outlet channel side slopes have suffered erosion on both banks due to extremely high releases during conduit gate rating and prototype testing in spring 1973. Most seriously eroded area is on right bank immediately downstream of stilling basin. (Periodic Inspection No. 4). | Tenatively plan to riprap areas to prevent further erosion. Final plans and construction will be accomplished as funds become available. |
| 23. | Embankment - Movement of structural features. Service bridge to tower. | Small northward horizontal movement recorded by tower bridge alignment survey. Present quantity of movement presents no danger to structure. (Periodic Inspection No. 4). | District continuing observations on regular schedule. No further action scheduled. |
| 24. | Spillway - Upstream wet area. | Wet area observed in upstream end of spillway; recommended drainage by shallow trenching if site conditions permit (Periodic Inspection No. 4). | District to survey area to determine drainage feasibility. |

Beltzville Lake

Pohopoco Creek, Pennsylvania

Dam, Outlet Works and Spillway

Periodic Inspection Report No. 3 and 4

## 1. AUTHORITY AND SCOPE

This report has been prepared in accordance with Engineer Regulation 1110-2-100, entitled "Periodic Inspection and Continuing Evaluation of Completed Civil Works Structures".

Due to the emergency workload and priorities generated by tropical storm "Agnes" which occured during June 1972, the report submission for the third periodic inspection of Beltzville Lake was delayed to the extent of overlapping the fourth periodic inspection. At the time of the fourth periodic inspection, District representatives requested approval of presenting both the third periodic inspection, conducted 14-15 September 1972, and the fourth periodic inspection, conducted 23-24 August 1973, in one report. Approval was received at a later date and this report accordingly presents results of both inspections. In addition, this report presents instrumentation readings obtained subsequent to the second periodic inspection, updates the construction history of the project, presents remedial measures adopted by the District and provides a brief evaluation study of seepage noted at the downstream toe of the embankment. The report also includes a presentation of the environmental quality control equipment presently installed and a summary of the difficulties experienced to date with this equipment.

In accordance with ENAW-RX 2nd Indorsement to LAD basic transmittal letter dated 4 February 1971, subject "Beltzville Lake, Periodic Inspection Report No. 1", as-built drawings showing significant project features are included in Appendix A of this report. The appendix is intended to supplement the as-built drawings presented in the first periodic inspection report for Beltzville Lake and will be referred to in future periodic inspection reports for specific as-built details of the project.

## 2. CONSTRUCTION HISTORY

The construction history of dam site facilities and Phase I clearing contract to elevation 586, were presented in Periodic Inspection Report No. 2.

The Phase II clearing, awarded 18 July 1970 to Demolition of Buffalo Corporation, consisted of clearing and grubbing the portion of the reservoir area between elevation 586 and elevation 628, normal operating level. The Phase II clearing was completed on 16 July 1971 at a cost of $169,400.

The recreation contract, awarded 1 September 1970 to A. L. Proctor Company, Incorporated, consisted of construction of a boat launching ramp, parking [illegible] appropriate [illegible] facilities, picnic area, roads and parking facilities and a sewage treatment plant downstream of the embankment. The recreation contract was completed on [illegible] May 1972 at a total cost of [illegible].

2. [illegible]

As required by [illegible] "Periodic Inspection and Continuing Evaluation of Completed Civil Works Structures", a system of continuing evaluation including periodic inspection was planned to assure the safety and stability of the Belleville Lake Project. These periodic inspections are planned to see problem areas and to provide a basis for recommendations of remedial treatment if and when required. Periodic inspections for Belleville Lake have been performed or are tentively scheduled in the following sequence:

| Inspection | Time Interval | Scheduled Date | Actual Date |
|---|---|---|---|
| Initial | | July 1970 | 20 July 70 |
| 2nd Periodic | 1 year | July 1971 | 22 July 71 |
| 3rd Periodic | 1 year | July 1972 | 14-15 Sep 72 |
| 4th Periodic | 1 year | July 1973 | 23-24 Aug 73 |
| 5th Periodic | 1 year | July 1974 | - |
| 6th Periodic | 1 year | July 1975 | - |
| 7th Periodic | 2 years | July 1977 | - |
| 8th Periodic | 2 years | July 1979 | - |
| 9th Periodic | * | * | - |

* Inspections following the two year interval will be increased to a one year frequency if justified by the results of previous inspections.

4. [illegible]

The third and fourth periodic inspections were attended by representatives of North Atlantic Division and Philadelphia District. Lists of those attending are included in Appendix B.

5. [illegible] PERIODIC INSPECTION - 14 & 15 SEPTEMBER 1972

Pool elevation at the time of the inspection was Elevation 627.3 which is [illegible] feet below the normal pool elevation of 629 and is 129.3 feet above the normal pre-impoundment river elevation. The reservoir has reached normal pool elevation on 18 Dec 1971, and with some fluctuation (- [illegible] to [illegible] feet) had remained at that elevation until the time of the inspection.

Upon arrival at the project site, the inspection party was briefed on the results of the first two periodic inspections. Reports of the 2nd Periodic Inspection were made available to the team members to familiarize them with the project and its condition at the time of the inspection. A review of the instrumentation data collected since the last inspection was made prior to initiating the inspection and a detailed check list was supplied to each party member for use during the inspection. The party inspected the intake tower, conduit, stilling basin, embankment and spillway areas on 14 September 1976. On 15 September 1976, the party inspected the reservoir area, including the recreation area.

Following the inspection, a critique was held in the project office in which discussion followed the checklist which had been furnished. All comments made at this critique were noted and are summarized in the following paragraphs:

(1) Intake Tower

a. Service Bridge

(1) Concrete surfaces - good condition
(2) Concrete cracks - none noted
(3) Expansion joints - good condition
(4) Drainage system - good condition
(5) Structural steel - good condition
(6) Bearings - good condition
(7) Guard rails & fencing - good condition
(8) Bridge movement - none noted.

b. Intake Tower

(1) Structural - concrete surfaces (cracks and leakage) - No major deficiencies were noted. Minor cracking noted in top deck of tower. Some minor leakage at joints and form tie locations below pool level.

(2) Equipment

(1) Service gates and hoists - no deficiencies noted
(2) Emergency gates and hoists - no deficiencies noted
(3) Water quality control gates and hoists - gate does not close completely having an opening of 0.4 inches in the closed position. Study of this problem and possible remedial treatment has been initiated.
(4) Sluice gates and hoist - The number 1 sluice gate has a bent stem and cracked casing and indicators are loose. The problems are under study and the stem and casing will be replaced and indicators repaired.

Elevator - The elevator was not operational at the time of the inspection. Inspection & repair of the system was accomplished by factory representatives during the week of 17 Sept 1972. Shorts in the power cable and corrosion of relay contacts due to high humidity in the tower are the primary causes of these operational problems. A study of the humidity problem and possible corrective measures has been initiated.

Sump pump and by-pass drain - no deficiencies noted.

Electrical (general) - water is present in electrical conduits and boxes at lower elevations. Surface mounting of outlets to prevent trapping of water & repair of one dead portable heater socket at El. 548 was recommended.

General - providing for heat in the lower levels of the tower is a problem. A study of this problem and possible corrective measures has been initiated.

(2) Conduit and Stilling Basin

(a) Conduit

(1) Concrete surfaces - no deficiencies, except for minor spalling, were noted. Location and extent of spalling virtually unchanged from those noted in 1971 survey.

Concrete cracks - location and extent of cracking was virtually unchanged from those noted in 1971 survey.

(2) Leakage - no new leakage was noted, leakage thru cracks and joints was less than that noted in last condition survey, primarily due to calcite deposits sealing cracks.

Joints - overall condition good, minor spalling at joints shows little change since last condition survey. Some leakage at joint at Sta 11 + 53.5 was noted.

Water passages including drains - cover plate missing at pressure cell location T-6 in water quality control outlet; cover plate will be replaced after completion of repairs to water quality control gate stem.

(b) Stilling Basin

(1) Concrete surfaces - in good condition, no deficiencies noted.

(2) Concrete cracks - minor, no change since last inspection.

(3) Leakage - none noted

(4) Joints - minor spalling noted at vertical contraction joints on left wall.

(5) Drains - all drains and weepholes appear to be open and functional.

(3) Embankment

a) Surface cracks - none noted

b) Abutment and embankment junctions - no deficiencies noted.

c) Vertical and Horizontal Alignment - minor movements revealed by surveys and instrumentation data are consistent with anticipated behavior.

d) Unusual movement or cracking at toe - none noted.

e) Unusual through embankment or downstream seepage - A seep in the rock cut to the right of the stilling basin was noted during the winter and early spring of 1972 and had continued to flow throughout the summer to the time of the inspection. This seep appears to have a base flow of approximately 0.025 cfs based on 8 months of weir readings. The base flow of the seepage emerging at the junction of the downstream toe of the dam and the left abutment (See Condition Report No. 2 for photographs and additional discussion) had increased from 0.2 to 0.3 cfs during the filling of the reservoir in 1971-1972. Measurements of this flow were made at a weir installed in August 1971. A more complete discussion of this downstream seepage is included in Section 8 of this report.

f) Sloughing or erosion of embankment or abutment slopes - Erosion at the junction of the downstream toe of the embankment and the right abutment in the vicinity of the stilling basin, noted in previous inspections, has continued.

The inspection team recommended a detailed study of the problem be made to determine the best remedial measures and that the corrective measures be implemented prior to the next scheduled inspection. Without benefit of a detailed study of the problem, installation of a paved ditch along this junction appears the most feasible solution.

g) Movement of structural features in the embankment - none noted.

h) Riprap failure (major displacement) - none noted.

(4) Spillway

a) Bridge

(1) Concrete surfaces - Good condition, no deficiences noted.

(2) Concrete cracks - none noted

(3) Expansion joints - Expansion joint at the north abutment requires cleaning and replacement of joint material.

(4) Drainage system - no deficiencies noted.

(5) Structural steel - no deficiencies noted.

(6) Bearings - no deficiencies noted.

(7) Guard rails - many nuts holding guard rail to bridge parapet are not tight against the railing base; nuts should be tightened to required torque.

(8) Bridge movement - none noted.

(b) Chute and Gravity Walls

(1) Concrete surfaces - some new spalling was noted in the center slabs upstream of the bridge, the condition of remainder of the chute is the same as noted during the 1971 survey.

(2) Concrete cracks - no appreciable change since 1971 condition survey.

(3) Expansion joints (material and displacement) - expansion joints show little change from that noted in 1971 inspection. Possible replacement following next inspection judging from present condition.

(4) Drainage system - general condition is good. Inspection team recommended installation of screens at outlet end of collector pipes to prevent entry of animals and possible blockage.

(5) Leakage - none noted.

(c) Other Miscellaneous

(1) Spillway side slope - erosion noted along right side of spillway cut upstream of chute. Repair of eroded section and installation of slope pipe to carry flow was recommended.

(2) Miscellaneous - In answer to head dam operator's question, team recommended cutting saplings which are growing in upstream section of spillway before additional growth makes removal difficult.

(5) Downstream Area

a) Erosion and Drainage - see comment (3)(f).

b) Surface cracking - none noted.

c) Weirs - Team recommended reinstallation of weir in ditch to right of stilling basin and installation of weir at upstream end of pool to determine quantity of seepage from zone noted at left abutment and downstream toe junction.

d) Sawmill Run erosion area - work has been initiated on the major remedial work in this area and was progressing satisfactorally at the time of the inspection.

(c) Upstream Reservoir Areas

a) Erosion of reservoir side slopes - none noted.

b) Condition of highway embankment riprap - condition good at all embankments inspected.

c) Concrete ditches - no deficiences noted.

d) Highway bridges - no deficiencies noted.

e) Recreation area - condition generally satisfactory. State park Manager and federal dam tenders reported a potentially dangerous situation at the boat lunching ramp. During first summer's operation, two cars rolled back down the launching ramp and did not stop until covered with 10 to 15 feet of water. In one of these cases, the vehicle was in "Park" transmission position, the emergency break was on and a wheel or wheels were chocked. In spite of these precautions, the loads induced while pulling the boat onto its trailer were enough to override these precautions. Although neither incident resulted in any more than vehicle damage, State and federal personnel expressed concern over the danger of personal injuries or deaths in a case of reoccurence. Apparently it is common practice for people (including children) to remain in the towing vehicle while a boat is being off or on loaded onto a boat trailer. Based on the demonstrated danger of this facility, it is recommended that some sort of barrier be installed to prevent cars and trailers from rolling into deep water because of the relatively steep slope of the ramp and lack of any obstruction to such movement. This barrier should be placed so as to allow approximately 4' between the top of the barrier and the water surface. The barrier should also be movable to allow its placement to provide the aforementioned clearance under fluctuating pool conditions.

6. RESULTS OF FOURTH PERIODIC INSPECTION - 23 & 24 AUGUST 1973

Pool elevation at the time of the inspection was 628, which is the normal operating reservoir elevation. Minimal fluctuation in pool level, within one foot of the operating reservoir level, is normally maintained by operating personnel except during periods of excessive rainfall.

The inspection party was briefed on the results of the first three periodic inspections and furnished with comments from the third periodic inspection. Updated instrumentation readings were presented and discussed together with results of a preliminary analysis of embankment seepage. A detailed check list was then supplied for use during the inspection. The party inspected the intake tower, downstream contact and seepage zone, conduit, roadway and sewage treatment plant areas during the first day and the upstream contact zone, roadway bridges, roadway embankments and recreation areas during the morning of the second day.

Following the inspection, a critique was conducted in the project office based on the checklist which has been furnished. All comments made at the critique were recorded and are summarized in the following paragraphs:

(1) Instrumentation Data Review of settlement point, piezometer and VWI data revealed no unusual conditions, with the exception of the movement of settlement point SP-5. This point, located at Station 8 + 901 has settled 0.34 feet (about 0.5% of embankment height) and moved horizontally 0.14 feet away from the centerline in the three year period from 9 July 1970 to 3 July 1973. Other surface settlement points in this vicinity (8 + 400 to 9 + 230 have settled no more than 0.25 feet and moved horizontally 0.09 feet or less. The installation at SP-5 was inspected by the team and was in satisfactory condition. There is no evidence of distress in the embankment in this area and it is concluded that the settlement is due to locally greater consolidation of the fill. Monitoring of all instrumentation will continue on the present schedule.

(2) Intake Tower

(a) Service Bridge

(1) Concrete Surfaces - Minor spalling noted at deck slab-parapet intersection.

(2) Concrete Cracks - None noted

(3) Expansion Joints - Joint sealer at joints between spans is deteriorating. Replacement necessary in near future

(4) Drainage System - No deficiencies noted

(5) Structural Steel - Paint beginning to show signs of age. Some blistering noted. Painting will probably be necessary in 2 to 4 years (1975 to 1977)

(6) Bearings - Generally satisfactory. Movable bearing at center pier is apparently frozen. No physical reason apparent, however dam tender will loosen nut on anchor bar which extends through slot in bearing pad.

(7) Guard Rail and Fencing - No problems noted

(8) Bridge Movement - Minor movement has been noted during instrumentation surveys

(b) Intake Tower

(1) Structural

(a) Concrete Surfaces - No deficiencies noted

(b) Concrete Cracks - No additional cracks noted since previous inspection. Top deck slab continues to leak. Recommend trial use of fiberglass cloth-epoxy combination for repair

(c) Leakage - Leakage at form tie locations and joints below water line appears less than previously noted. Calcite formation and dehumidification system credited for improvement

(2) Equipment

(a) Service Gates and Hoists - No deficiencies noted.

(b) Emergency Gates and Hoists - No deficiencies noted.

(c) Water Quality Control Gates and Hoists - Control gate leaks around stem seal at certain gate settings. Deficiency appears to involve machining of gate stem.

(d) Engine Generator - Hydraulic starter for emergency engine generator is difficult to re-prime and the diesel engine fail to start. Re-priming by hand crank to required 2500 psi takes about 20 minutes. The problem will be investigated to determine if electrical battery-powered system would prove more dependable.

(e) Sluice Gates & Hoist - No deficiencies noted

(f) Elevator - No malfunctions noted. Permanent repairs have been completed since last periodic inspection. Maintenance contractor keeping elevator in working order.

(g) Dehumidifier - fabrication of system being completed. System is functioning but work had not been finally accepted at the time of inspection.

(h) Sump pumps & By-pass Drain - No problems noted

(i) Electrical - Most deficiencies noted in third periodic inspection have been repaired by District electrician. A few receptacles are still to be reset.

(3) <u>Conduit and Stilling Basin</u>

a) Conduit

(1) Concrete Surface - No change noted since previous inspection

(2) Concrete Cracks - No change noted since previous inspection

(3) Leakage - Construction joint at station 11 + 50 continues to leak as noted in second and third periodic inspections

(4) Joints - No major problems noted. Spalling at construction joints at conduit station 0 + 94 and north chamber station 0 + 34. Spalls appear to be result of patch failures.

(5) Drains - No deficiencies noted

(b) Stilling Basin

(1) Concrete Surfaces - No changes noted since previous survey

(2) Concrete Cracks - No changes noted since previous survey

(3) Leakage - None noted

(4) Joints - No deficiencies noted

(5) Drains - Weep holes appear to be functioning properly

(6) Other - Outlet channel side slopes have suffered erosion from high releases and conduit rate rating and prototype testing performed by WES during the spring of 1973. Protection of eroded areas in weathered shale by riprap placement was recommended. Outlet channel earth slopes should be seeded.

Some seepage along left side of outlet channel was noted. This seepage emerges from rock and appears to be no problem at present.

(4) Embankment

(a) Surface Cracks - None noted

(b) Abutment and Embankment Junctions - No problems noted

(c) Vertical and Horizontal Alignment - Satisfactory. Analysis of instrumentation readings should continue at present schedule with attention to settlement at SI-5

(d) Unusual Movement or Cracking at or Beyond Toe - None noted

(e) Unusual Through Embankment or Downstream Seepage - NAD personnel concurred in limiting the study of seepage to analysis of embankment through-seepage. Preliminary seepage analysis indicates observed seepage is not abnormal for this embankment and pool height, NAD recommended continued monitoring of the weir system and that seepage noted coming off the steep left abutment be observed and any deviations from present patterns be noted. Project maintenance forces will repair Weir No. 1 which was allowing a small amount of water to bypass its left side.

(f) Sloughing or Erosion of Embankment and Abutment Slopes - Minor erosion along the right abutment - embankment contact zone on the upstream side of the embankment was noted as previously reported in the 2nd Periodic Inspection. Recommend project forces reshape ditch or provide check dams to prevent undermining riprap in this area.

(g) Movement of Structural Features in Embankment - Small northward horizontal movement was recorded by the tower bridge alignment survey at the eastern bridge slabs nearest the tower. Continued observation to determine if movement is active was recommended. Present amount of movement (0.049 foot maximum) presents no danger to the structure

(h) Riprap Failure - Major Displacement - None noted

Spillway

a. Bridge

(1) Concrete Surfaces - No deficiencies noted

(2) Concrete Cracks - None noted

(3) Expansion Joints - Joint sealant showing deterioration. Replacement not required at this time, however monitoring is recommended.

(4) Drainage System - No deficiencies noted

(5) Structural Steel - No deficiencies noted. Paint beginning to show signs of aging, however repainting is not recommended at this time

(6) Bearings - No deficiencies noted

(7) Guard Rails - No problems noted. Nuts on railing anchor bolts have been tightened since third periodic inspection

(8) Bridge Movement - No evidence of movement noted. Monumentation of bridge for vertical and horizontal movement should be completed. Survey measurements to be taken on three months interval compatable with existing survey schedule. Vertical alignment to be established on northward pier to determine reason for joint material extrusion along south edge of pier and spillway slab contact

b. Chute and Gravity Walls

(1) Concrete Surfaces - No significant change noted since previous inspection

(2) Concrete Cracks - No change noted since original crack survey performed subsequent to second periodic inspection

(3) Expansion Joints - Joint along left side of north spillway bridge pier at spillway chute slab is very tight extruding the joint filler material. The joint space on the right side of this pier shows a corresponding open space so that the joint material no longer fills the entire space. The reason is not readily apparent but has been noted on all previous inspections. The pier will be monumented to determine whether any movement is taking place in the bridge.

(4) Drainage System - No problems noted. Screens have been installed to prevent entrance of small burrowing animals into underdrain system as recommended in previous inspections

(5) Leakage - None noted

[illegible]

[illegible] areas located on upstream end of spillway were observed. Recommend drainage of this area by shallow ditching be investigated.

[illegible] personnel recommended that construction files be researched for spillway slope configuration immediately after excavation and for comparison with present slopes. Available photographs should be utilized.

[illegible] Area

[illegible] Erosion and Drainage - As mentioned in paragraph 3[illegible] [illegible] erosion of the outlet channel has taken place and corrective action is recommended. The installation of drainage pipe from Delta Borrow Area to Saw Mill Run has been completed and is performing satisfactorily.

[illegible] Cracks - None noted

[illegible] - Monitoring to continue and aforementioned repairs to Weir No. 1 will be accomplished by operating personnel.

[illegible] Treatment Plant - Condition good. State operator explained his intent to change trickling filter outlets (reversal of 1st and 3rd outlet sizings) to better distribute the effluent onto the filter material. Change was agreed to by NAP and NAD personnel.

[illegible] Area

a. Erosion of Reservoir Slopes - No problems noted except for small amount of erosion in several minor areas. Dam tender will continue annual inspections of the shoreline to locate and record eroded areas.

b. Condition of Highway Embankments and Riprap - No deficiencies noted

c. Concrete Drainage Ditches - Good condition. No problems noted

d. Highway Bridges - L.R. 13015 bridge approach shoulders on left side are badly eroded. Since this is a state road, the maintenance forces responsible for the work will be contracted informally and made aware of the potentially hazardous condition should the erosion continue. Bridges along the relocated highways are in good condition.

e. Recreation Areas. No problems noted. No recurrence of problems noted during the third periodic inspection with cars sliding into water at boat launching ramp while attempting to off or on load boats. Boat launching ramps are being swept clean of loose gravel which may have contributed to former problems.

[illegible]

[illegible] corrective measures [illegible] undertaken [illegible] District personnel [illegible] problem areas or investigate problem solutions. The inspection comments [illegible] corrective measures undertaken or problems investigated are listed below:

a. Periodic Inspection No. [illegible]

[illegible] 4. "[illegible] abutment junctions: Erosion [illegible] along both upstream [illegible] abutments. [illegible] should be diverted from the [illegible] to reduce erosion." The [illegible] personnel, as a portion of their maintenance duties, are filling the drainage ditch and regrading the junction area upstream of the embankment to provide drainage away from the riprap toe. Subsequent inspections by District office personnel determined that the filling and regrading is alleviating the erosion problem.

[illegible] 4. "[illegible] embankment or downstream seepage: Small springs were observed along left abutment, downstream of dam. District will monitor the flow by observation and/or installation of a weir." The initial weir was installed on 15 August 1971, immediately after Periodic Inspection No. [illegible], and monitoring of the seepage was begun. A more detailed explanation of actions taken relative to the downstream seepage is contained in paragraph 8 of this report.

[illegible] Page 5. "Water passages including drains: Pressure cell cover, located in the floor of water quality control chute was missing and will be replaced by District forces. See paragraph 7b. (6)."

[illegible] Page 6. "A ditch, which runs from the downstream toe to 25 feet in [illegible] with overhanging trees, presents a safety hazard to the public." A contract was awarded to George R. Lynn, Incorporated, on 27 June 1972 for erosion control at this ditch. Approximately 180 feet of 48-inch diameter reinforced concrete pipe and 200 feet of 36-inch diameter reinforced concrete pipe were installed and backfilled in the erosion area. The contract for this work was completed on 15 April 1973.

(b) Periodic Inspection No. 3 (Section 5 of this report)

1) Paragraph 5 (1)(c)(3). "Water quality control gates and hoists - Gate does not close completely having an opening of 0.4 inches in the closed position. Study of the problem and possible remedial treatment has been initiated." A study of this problem indicates the slight opening does not affect the safety or operation of the project. In addition, the control gate can be closed manually should complete shut-off of this gate required.

2) Paragraph 5 (1)(c)(4). "Sluice gates and hoist - The number 1 sluice gate has a bent stem and cracked casing and indicators are loose. The problems are under study and the stem and casing will be replaced and indicators repaired." The bent stem and cracked casing were replaced during the spring of 1973. The remaining stems were checked for adjustment and adequate performance.

3) Paragraph 5 (1)(c)(5). "Elevator - The elevator was not operational at the time of the inspection. Inspection and repair of the system was accomplished by factory representatives during the week of 17 September 1973. Shorts in the power cable and corrosion of relay contacts due to high humidity in the tower are the primary causes of these operational problems. A study of the humidity problem and possible corrective measures has been initiated." A contract for dehumidification of the intake tower was awarded on 23 May 1973 and, although not completed the system was in operation at the time of the fourth periodic inspection.

4) Paragraph 5 (1)(c)(7). "Electrical (General) - water is present in electrical conduits and boxes at lower elevations. Surface mounting of outlets to prevent traping of water and repair of one dead portable heater socket at El.54" was recommended." The lower elevation wiring has been replaced completely at the lower tower levels. The outlets and mountings have been modified to insure free drainage of water from the conduits.

(5) Paragraph 5 (1)(c)(8). "General - providing for heat in the lower levels of the tower is a problem. A study of this problem and possible corrective measures has been initiated." The dehumidification contract mentioned in (3) above also included complete revision of the heating system to provide adequate tower heating at the lower levels.

Paragraph 5 (2) a)(5). "Water passages including drains - cover plate missing at pressure cell location T-6 in water quality control outlet; cover plate will be replaced after completion of repairs to water quality control gate stem." Pressure cell cover plate was replaced in spring of 1973 while testing the conduit for prototype comparison with WES model.

Paragraph 5 (4)(a)(7). "Guard rails - many nuts holding guard rail to bridge parapet are not tight against the railing base; nuts should be tightened to required torque." The dam operating personnel, as part of their maintenance duties, re-tightened the loose anchor bolt nuts.

Paragraph 5 (4)(b)(4). "Drainage system - general condition is good. Inspection team recommended installation of screens at outlet end of collector pipes to prevent entry of animals and possible blockage." The screens were installed by dam operating personnel as part of their normal maintenance duties. Future weep holes design for other projects should include installation of screens of nondeteriorating material. The screens should be removable to allow weep hole cleanout should this become necessary.

Paragraph 5 (4)(c)(1). "Spillway side slope - erosion noted along right side of spillway cut upstream of chute and repair of eroded section and installation of slope pipe to carry flow was recommended." The erosion was being caused by a low area (3 to 4 feet) in the right side top-of-cut spillway drainage ditch. The dam tender has regrading the drainage ditch to provide a continuous ditch grade, thus preventing the water runoff over the spillway side slope. The side slope erosion area has been reseeded for bank stabilization.

Paragraph 5 (4)(c)(2). "Miscellaneous - In answer to dead dam operator's question, team recommended cutting saplings which are growing in upstream section of spillway before additional growth makes removal difficult." Dam operating personnel have removed or cut the saplings.

(11) Paragraph 5 (5)(c). "Weirs - Team recommended reinstallation of weir in ditch to right of stilling basin and installation of weir at upstream end of pool to determine quantity of seepage from zone noted at left abutment and downstream toe junction." The right abutment weir was reinstalled

and upstream weir near the left abutment was installed by project operating personnel. A more detailed explanation of the actions taken is contained in the Seepage Study, section 8 of this report.

7. SEEPAGE [illegible]:

a. [illegible]

1 Embankment Construction. Construction records and recollections of design and construction personnel at the Beltzville project indicate the existence of small springs on the creek left abutment, downstream of the embankment prior to embankment construction. To provide drainage for runoff, a portion of the original creek channel downstream of the embankment was left open whereas the remainder of the channel was used as a spoil area for deposition of random material used for the downstream cofferdam. This open portion of the original stream channel contained the flow emerging from downstream abutment springs prior to impoundment however it is not known whether the springs were present in dry periods.

(2) First Periodic Inspection. The first periodic inspection team noted the ponding of water in the original stream channel, however no seepage was evident in the immediate vicinity of the embankment toe. The first periodic inspection took place prior to impoundment and, therefore the ponding of water was attributed to the stream grade and rainfall runoff. No embankment seepage was noted during the initial inspection.

(3) Second Periodic Inspection. During July 1971, the second periodic inspection team noted seepage emerging from the embankment in the vicinity of the original stream channel. Pool level was elevation 602, twenty-six feet below normal operating pool. The suggestion was made that a weir be installed to measure the flow, and establish its relation to reservoir elevation. Weir 1 was installed in the old stream channel and readings began in August 1971.

(4) December 1971. During December of 1971 the head dam operator noted a continuous seepage in the vicinity of the right abutment and embankment junction immediately right of the stilling basin. This area has shown intermittent flow during periods of rainfall (see photographs 3 and 3-A of Periodic Inspection Report No. 2), however the flow appeared continous at this time.

Third Periodic Inspection. The third inspection team (14 September 1972) suggested two additional weirs be installed and requested a study of the seepage. Weir 2 was installed near the embankment toe and left abutment intersection to measure the seepage at this point and Weir 3 was installed to the right of the stilling basin to monitor the seepage noticed during September 1971.

(4) Fourth Periodic Inspection. The fourth inspection team (23 August 1973) reviewed a preliminary seepage analysis and concurred in the scope of study. The team inspected the weirs and seepage area and recommended seepage around weir no. 1 be corrected and the springs on the left abutment be observed. The inspection team also noted small seeps not being monitored by the weir system in the rock at the left side of the outlet works channel. Monitoring of this seepage is not practicable because of the scattered locations and irregularity of the rock.

b. Weir Reading Results

1) Weir No. 1. Weir No. 1, is located in the original stream channel approximately 400 feet downstream of the embankment toe along the steep left abutment. Weir readings obtained during the first two months of monitoring indicated a direct comparison between rainfall and weir discharge and a base flow during periods of minimal precipitation. As reservoir impoundment progressed from elevation 605 to elevation 620, the base flow recorded in weir no. 1 increased to 0.4 cfs (180 gal/min) where the base flow appears to have stabilized. Individual heavy rainfalls have produced recorded discharges as high as 2.0 cfs, the maximum recordable by this portable weir.

2) Weir No. 2. Weir No. 2, is located near the intersection of the left abutment and embankment toe. Readings from this weir indicate a direct correlation with rainfall runoff and a base discharge of approximately 0.2 cfs (90 gal/min).

3) Weir No. 3. Weir No. 3, is located on the right abutment-embankment interface to the right of the stilling basin. This weir, which fluctuates less with rainfall than either weir 1 or weir 2, appears to hold a base flow of approximately 0.02 cfs (10 gal/min). Weir monitoring results, plotted along with rainfall and pool elevations, for the three weirs are shown on plate 18.

(4) Discussion. Weir readings indicate that the base flows in the three weirs have stabilized since the reservoir normal operating level was reached. The base flow is taken as a measurement of seepage and the lack of increase in the base flow after reaching full pool indicates a safe controlled flow range. Sources of the base flow (0.[illegible] cfs, 1[illegible]0 gpm) measured at Weir 1 included embankment through-seepage and underseepage through the rock foundation in the valley, left abutment and adjacent portion of the right abutment, all of which would be collected in the old stream channel and flow to this weir. An estimate of the embankment seepage is made in the following paragraphs for comparison with the flow at Weir 1. In this estimate the limit of the embankment portion on the right abutment contributing flow to Weir 1, as indicated by the true slope of the base portion of the internal drain, is Station 9 + 000. Seepage originating to the right (north) of this station is either dissipated into the curved valley in that area or, if there is longitudinal flow in the rockfill zone, intercepted at the conduit and discharged through rock backfill into the outlet channel.

(5) Computation of Embankment Through-Seepage Sta 9 + 000 to 1[illegible] + 000.

a) Embankment Permeability and Flow Nets. The seepage computations are based on flow nets prepared for two limiting assumptions as to effective size and permeability of the impervious barrier. This was done to consider the effect of variable permeability in the random zone adjacent to the core which ranged from material with permeability characteristics the same as the core to material with significanty higher permeability. Accordingly, flow nets were drawn assuming in one case an impervious zone the same as the core and, in a second case, a larger impervious zone which includes the core, random fill between the core and drainage zone, and a portion of the adjacent random fill on the upstream side.

b) Coefficient of Permeability and Seepage Quantity. From tests during the design phase and observation of materials actually placed the permeability of the core is considered to range from 1 x 10 $^{-4}$ to 1 x [illegible] cm/sec. Computations using these values are shown on the flow nets. The resulting four flow rates are [illegible], 1[illegible], 40 and 150 gpm; from which it is likely ([illegible] chance by statistical methods) that the embankment through-seepage is between [illegible] and [illegible] gpm. Thus [illegible] or more of the 1[illegible]0 gpm

base flow at Weir 1 apparently originates from other sources. It is reasonable to attribute this portion to the foundation rock since seepage can be seen emerging from rock in the outlet channel area and rather large grout takes occurred in two holes during curtain grouting at the left abutment. The vertical cracks in rock in the left abutment cutoff trench area (oriented approximately parallel to centerline and treated with a special mortor application) may also be a factor in this flow.

Piezometer Readings. No unusual conditions are shown by the embankment and foundation piezometers. The internal drain from these data appears to be functioning as designed and maintaining a satisfactory drained state in the downstream portion of the embankment.

Evaluation. The weir readings and stabilization of the base flow after reaching full pool show that the seepage is, to the present, a small and controlled discharge which, from embankment seepage computations and other indications, originates primarily from the rock foundation. Since the flow is small and stabilized and there is no visual or instrumental evidence of any harmful effects, the seepage is not considered to represent any serious problem. Monitoring of the weir flows will continue.

9. RESULTS OF INSTRUMENTATION

The results of readings on the existing instrumentation during the construction period and during impoundment to elevation 612 were presented in previous periodic inspection reports. A brief discussion of instrumentation elevation 628 and instrumentation results during post impoundment prior to the fourth periodic inspection follows:

a. Piezometers. During the final impoundment stage, as had been experienced throughout the reservoir filling, the piezometers reacted in accordance with their relative position in the embankment. General piezometric patterns established during the initial reservoir filling continued during the final filling from elevation 612 to elevation 628. Those piezometers located upstream of the impervious core rose at the same rate, or slightly slower, than the reservoir rise. The piezometers located in the impervious core material indicated a rise in water level, however, the rise occured at a much slower rate than the reservoir rise. The pressure cells located downstream of the impervious core indicated minor rises in pore pressure or no pore pressure readings.

After normal operating pool elevation has been achieved, the piezometer and pressure cell readings stabilized at relatively constant values. Most upstream piezometers (PZE 77-1, PZE 95-1 and PZE 98-1) stabilized at or near the reservoir operating elevation 628. Two additional upstream piezometers, PZE 86-1 and PZE 92-1, indicated minor discrepancies from the general behavioral patterns established under normal pool elevation. Possible reasons for the non-typical behavior exibited by these piezometers are presented in the second periodic inspection report.

Impervious core piezometers (PZC 77-2, PZC 95-3 and PZC 98-2) indicate piezometric water levels from 8 to 37 feet below pool elevation as of August 1973. The impervious core piezometer levels appear to relate to embankment width and hence length of seepage path to the piezometer tip location.

The downstream pressure cells have shown rises in water pressure readings from 0 to 11 feet. The maximum 11 foot rise, recorded in pressure cell PPF 98-3, is well below the water level assumed during steady seepage design calculations and appears to be a normal condition.

Two downstream pressure cells have become inoperative since their installation into the embankment and contributed little information prior to malfunction. The reason for the malfunctions are are not apparent at this time. District personnel are presently planning to replace the inoperative pressure cells with Casagrande-type open piezometers since these instruments appear to provide more serviceability and reliability.

With the exception of the two inoperative pressure cells the piezometer instrumentation appears to be performing satisfactorily. There are no important deviations from theoretically anticipated behavior and the internal drain in the downstream slope of the embankment appears to be functioning as planned. Replacement of inoperative pressure cells will be made as funds become available.

b. Slope and Settlement Indicators. The slope and settlement indicators were established as embankment construction progressed to measure movements in three directions. Alignment of the instruments permit measurement parallel to the dam centerline (north-south), perpendicular to the dam centerline (east-west) and horizontal settlements within any portion of the embankment height. A summarization of readings was first presented in Design Memorandum No. 17 entitled Instrumentation, and updated in the first and second periodic inspection reports. The summarized readings, current as of 20 March 1973 are as follows:

| INSTAL-LATION | [illegible] FILL [illegible] BOTTOM [illegible] | MAXIMUM SETTLEMENT AND ZONE 3-20-73 | NORTH-SOUTH | DEFLECTION | | EAST-WEST | DEFLECTION | |
|---|---|---|---|---|---|---|---|---|
| VIF [illegible] (Left Abut) | [illegible] | [illegible] [illegible]-611.01' | North | 3.14" [illegible] 2.75" | 9/70 3/73 | East | [illegible].42" [illegible].41" | [illegible]/71 3/73 |
| VIF 95-2 (Closure) | [illegible] | 1.24' 604.72-609.72' | South | -3.04" -2.89" | 9/70 3/73 | East | 3.80" 2.18" | [illegible]/70 3/73 |
| VIF 98-5 (Left Abut) | 115' | 1.24' 608.79-613.79' | North | 1.73" 1.47" | 11/71 3/73 | East | 3.58" 3.17" | 9/71 3/73 |

expected, the majority of settlement to date occured during construction of the embankment; amounting to 76%, 83%, and 78% in installations VIF 92-2, 95-2 and 98-5 respectively. The embankment zone at which maximum settlement has occured correlates closely in the three instruments, as discussed in the second inspection report. The installations 92-2 and 95-2 have indicated maximum settlement changes since the second periodic inspection report of 0.02 and 0.05 feet, respectively, whereas instrument 98-5 has shown no maximum settlement increase.

All three inclinometers indicated an initial upstream (easterly) movement prior to impoundment and a downstream (westerly) trend during reservoir filling. The maximum movement in the east-west direction was recorded in instrument 92-2 during April of 1971 and the maximum movement in the north-south direction was recorded in 92-2 during February of 1970. During the period between the second periodic inspection (recordings of 29 September 1971) and the fourth periodic inspection (recordings of 20 March 1973), very little movement has occured in the inclinometers. These movements amount to less than 0.20 inches in the east-west direction (VIF 98-5) and less than 0.39 inches in the north-south direction (VIF 95-2) during the 17 month period.

c. Surface Settlement Pipes. Surface settlement readings, which are shown in Table 1 hereafter, were first presented in the second periodic inspection report. During the recording period from 5 October 1971 to 3 July 1973, the settlement indicated negligible movement in the horizontal (less than 0.10 feet) and vertical (less than 0.05 feet) with the exception of instruments SP-5 and SP-7 which exceeded these limits in the horizontal direction.

As presented in the second periodic inspection report, it was thought that a general pattern of behavior was being experienced in the vicinity of the temporary end-fill zone of the embankment: Station 7+000 to Station 9+400. This theory was based on settlement readings on pipes SP-4, SP-5 and SP-6 which indicated the three largest settlement readings of the seventeen settlement pipes. This trend remains, but is now apparently affecting only SP-4 where the settlement is 0.49 feet.

General behavorial patterns established by the settlement pipes since their initial installation, neglecting SP-5, indicates less than [illegible] inches horizontal and less than 1 inch vertical movement in the [illegible]-3 year recording period.

d. Tower Bridge. A study of the tower bridge movement in both the horizontal and vertical direction has been undertaken since August of 1971. The readings are obtained on a three-month schedule by survey branch personnel as the settlement pipe and inclinometer elevations are obtained. The survey points are punch marks located in the fixed plate and movable bar at each plate expansion dam of the bridge roadway. The points are numbered from one to ten beginning at the bridge-embankment abutment and proceeding eastward.

The results of the tower bridge movement are presented hereafter in Table 2. Results to date indicate very little movement has taken place at the expansion joint located above the middle pier of the three-span bridge (survey points [illegible] and [illegible]). The fourth periodic inspecton team inspected the expansion bearings at this location but could find no reason for the lack of movement. The dam operator was instructed to loosen the anchor bolt nut at the slotted expansion bearing to determine if the nut was preventing movement.

Vertical offsets measured along the bridge center line indicate a small upward movement at pier number 3. (survey points [illegible] and [illegible]) amounting to 0.04 feet. Specific reasons for this movement are not apparent, however the lack of movement at the pier number 2 expansion joint may be a contributing factor.

TABLE 1
SURFACE SETTLEMENT DATA

SETTLEMENT PIPE & OFFSETS & ELEVATIONS

| 1<br>INSTRUMENT NUMBER | 2<br>STATION | 3<br>HEIGHT OF FILL | 4<br>INITIAL SURVEY DATE | 5<br>INITIAL ℄ OFFSET | 6<br>℄ OFFSET (5 Oct 71) | *7<br>DIFF 5-6 | 8<br>INITIAL ELEVATION | 9<br>ELEVATION (5 OCT 71) | 10<br>DIFF 8-9 |
|---|---|---|---|---|---|---|---|---|---|
| SP-1 | 6+901.03 | 27 | 9 July 70 | 14.49 | 14.44 | -.05 | 672.04 | 672.03 | -.01 |
| SP-2 | 7+401.03 | 44 | 9 July 70 | 14.50 | 14.44 | -.06 | 672.04 | 672.02 | -.02 |
| SP-3 | 7+901.42 | 72 | 9 July 70 | 14.50 | 14.54 | +.04 | 672.06 | 671.98 | -.08 |
| SP-4 | 8+401.48 | 74 | 9 July 70 | 14.41 | 14.44 | +.03 | 672.03 | 671.87 | -.16 |
| SP-5 | 8+901.15 | 91 | 9 July 70 | 14.40 | 14.54 | +.14 | 672.04 | 671.55 | -.49 |
| SP-6 | 9+401.43 | 166 | 9 July 70 | 14.58 | 14.54 | -.04 | 672.02 | 671.82 | -.20 |
| LBS-1 | 9+580.0 | 172 | 18 Dec 70 | 14.44 | 14.48 | +.04 | 671.68 | 671.49 | -.19 |
| LBS-2 | 9+630.0 | 172 | 18 Dec 70 | 14.55 | 14.51 | -.04 | 672.00 | 671.85 | -.15 |
| LBS-3 | 9+680.0 | 172 | 18 Dec 70 | 14.58 | 14.54 | -.04 | 672.04 | 671.89 | -.15 |
| LBS-4 | 9+730.0 | 172 | 18 Dec 70 | 14.53 | 14.44 | -.09 | 672.05 | 671.90 | -.15 |
| LBS-5 | 9+780.0 | 146 | 18 Dec 70 | 14.79 | 14.74 | -.05 | 672.04 | 671.90 | -.14 |
| LBS-6 | 9+830.0 | 118 | 18 Dec 70 | 14.74 | 14.73 | -.01 | 671.97 | 671.79 | -.18 |
| LBS-7 | 9+880.0 | 116 | 18 Dec 70 | 14.55 | 14.53 | -.02 | 671.86 | 671.72 | -.14 |
| SP-7 | 9+901.71 | 116 | 9 July 70 | 14.51 | 14.52 | +.01 | 672.03 | 671.87 | -.16 |
| LBS-8 | 9+930.0 | 65 | 18 Dec 70 | 14.38 | 14.37 | -.01 | 672.12 | 672.01 | -.11 |
| LBS-9 | 9+980.0 | 16 | 18 Dec 70 | 14.53 | 14.55 | +.02 | 672.32 | 672.24 | -.08 |
| LBS-10 | 10+030.0 | 0 | 14 & 27 May71 | 13.67 | 13.66 | -.01 | 688.10 | 688.08 | -.02 |

* UPSTREAM POSITIVE (+); DOWNSTREAM NEGATIVE (-)

TABLE 2

TOWER BRIDGE MOVEMENT STUDY

FELTZVILLE LAKE

| MARK NUMBER | PUNCH MARK ELEVATIONS DATE | | | | | | TOWER BRIDGE CENTERLINE OFFSET - N (+) DATE | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 8/13/71 | 7/12/72 | 9/13/72 | 12/8/72 | 3/20/73 | 7/3/73 | 8/12/71 | 7/12/72 | 9/13/72 | 12/8/72 | 3/21/73 | 7/3/73 |
| 10 | 672.087 | 672.09 | 672.09 | 672.09 | 672.09 | 672.09 | - | - | - | - | - | - |
| 9 | 672.078 | 672.07 | 672.07 | 672.06 | 672.07 | 672.07 | 0.000 | 0.000 | 0.000 | 0.000 | 0.005 | 0.000 |
| 8 | 672.097 | 672.10 | 672.10 | 672.11 | 672.12 | 672.11 | 0.000 | 0.018 | 0.025 | 0.045 | 0.040 | 0.043 |
| 7 | 672.081 | 672.08 | 672.09 | 672.09 | 672.10 | 672.09 | 0.000 | 0.015 | 0.025 | 0.040 | 0.045 | 0.042 |
| 6 | 672.091 | 672.08 | 672.08 | 672.11 | 672.10 | 672.08 | 0.000 | 0.000 | 0.005 | 0.010 | 0.005 | 0.007 |
| 5 | 672.073 | 672.07 | 672.07 | 672.09 | 672.08 | 672.07 | 0.000 | 0.000 | 0.010 | 0.010 | 0.005 | 0.007 |
| 4 | 672.04[illegible] | 672.06 | 672.06 | 672.08 | 672.08 | 672.06 | 0.000 | 0.000 | 0.010 | 0.010 | 0.008 | 0.010 |
| 3 | 672.045 | 672.06 | 672.05 | 672.08 | 672.07 | 672.06 | 0.000 | 0.000 | 0.010 | 0.010 | 0.007 | 0.008 |
| 2 | 671.750 | 671.71 | 671.71 | 671.72 | 671.72 | 671.69 | 0.000 | 0.000 | 0.000 | 0.005 | 0.000 | 0.000 |
| 1 | 671.724 | 671.69 | 671.69 | 671.71 | 671.70 | 671.67 | - | - | - | - | - | - |

TABLE 2 (Continued)

TOWER BRIDGE MONITORING STUDY

FAYETTEVILLE, TEXAS

| MARK NUMBER | DISTANCE BETWEEN SPAN BENCH MARKS | | | | | |
|---|---|---|---|---|---|---|
| | DATE | | | | | |
| | 8/12/71 | 7/12/72 | 9/13/72 | 12/8/72 | 3/21/73 | 7/3/73 |
| 10 | | | | | | |
| | 0.500 | 0.495 | 0.505 | 0.500 | 0.495 | 0.495 |
| 9 | | | | | | |
| | | | | | | |
| 8 | | | | | | |
| | 0.496 | 0.490 | 0.515 | 0.565 | 0.545 | 0.505 |
| 7 | | | | | | |
| 6 | | | | | | |
| | 0.500 | 0.495 | 0.510 | 0.498 | 0.500 | 0.498 |
| 5 | | | | | | |
| 4 | | | | | | |
| | 0.500 | 0.490 | 0.520 | 0.568 | 0.550 | 0.505 |
| 3 | | | | | | |
| 2 | | | | | | |
| | 0.500 | 0.510 | 0.525 | 0.550 | 0.550 | 0.510 |
| 1 | | | | | | |

[illegible]al elevations taken at the bridge punch marks indicate little or no movement except at the bridge-embankment abutment which has settled 0.05 feet in the two-year observation period.

No problems have been indicated by the movement records. The District will continue to monitor this feature of the project and evaluate the movements.

[illegible] ENVIRONMENTAL QUALITY CONTROL EQUIPMENT

a. Operation. A description of the environmental quality control equipment presently installed at Beltzville Dam and a summary of the difficulties experienced to date with this equipment is presented herein as information to other Districts planning to install similar equipment in future projects.

The system is unique in that it records reservoir level, downstream creek level, dissolved oxygen, water temperature, acidity or alkalinity, and conductivity from eight water quality control gate levels on a rotational basis. The water from eight different reservoir sample levels flows through embedded pipes either to a [illegible] or to the water sample tank that contains the dissolved oxygen, temperature, PH, and conductivity analyzers. The constant flushing minimizes the effect of tower wall temperature on the measured parameters. The tower wall temperature effect is checked by thermocouples at each of the eight sample inlet locations and the sample tank.

Solenoid valves are used to direct water from the selected water level inlet location to the sample tank. The levels are automatically, sequentially, selected on a manually variable timed interval and the data is recorded on an outlet typewriter and or punched paper tape. Any inlet level above reservoir level is automatically locked out of the sampling cycle and any inlet level can be locked out manually.

The perfected process could provide scientific data on reservoir seasonal changes and provide selective withdrawal information necessary to meet future water quality criteria downstream of the project.

b. Installation and Operational Problems. The contract for installation of the environmental quality control monitoring equipment was awarded to Honeywell, Incorporated in August of 1970 and was specified for completion by 31 May 1971. The contract was awarded as a supply contract and, as such, provides for no liquidated damages.

The initial shop drawings were submitted by the contractor three months prior to the scheduled completion date and the final shop drawings were submitted five months after the scheduled completion date. There is no monitoring system presently in production to provide the information specified for Beltzville and, therefore, the system had to be fabricated from component units presently in production and modified to provide the required capabilities.

The greatest single problem source has been the typewriter-paper punch unit used for output data logging. The original unit provided by the contractor was rejected as incompatible with the system capacity requirements of the specifications. The automatic typewriter is required to reproduce the sensor output values on typed log sheets and the digital recording system to convert the analog signals from the individual parameter analyzers to digital format and reproduce them on an 8-channel punched paper tape. The "Briden" unit that was finally approved had a two months delivery time and required modifications for compatability with other components of the system. The unit was shipped to a subcontractor for modification and was damaged in shipping, thereby resulting in a further delay. The unit was connected to the system, checked during shop tests, and found to be producing about [illegible] percent accurate data. The problem has continued and the system had not been finally accepted as of September 1973.

The specification required the output devices to operate in three modes; type and punch concurrently, type only, and punch only. The contractor apparently overlooked the punch only mode and the machine required modification to incorporate this feature.

In addition to the major problem of data output and general unreliability of data, several lesser problems have been experienced with the system and its installation. Some of the lesser problems are noted below:

(1) The water jet for the dissolved oxygen analyzer was omitted from the sample tank originally. The omission had a very adverse affect on the dissolved oxygen response time and the water jet has since been installed.

(2) The electronic module for the conductivity analyzer was damaged, apparently by a lightning surge and has been replaced. The dam operator reports the system is highly sensitive to lightning and power surges.

(3) The data transmission line from the downstream stream gaging station, which is leased from Bell Telephone Company, broke and a temporary transmission line was installed.

(4) Two thermocouples for installation at the sample inlets had faulty water tight seals and were repaired. Two additional thermocouples were delayed in delivery to the site.

(5) Two conduits for thermocouple installation were blocked and had to be abandoned. These conduits were installed under the embankment and outlet works construction contract. Attempts to clear the conduits added to the delays in completion.

11. SUMMARY

The primary construction contract for the Beltzville Lake project was completed on 10 July 1970 at which time the project was considered fully operational for flood control purposes.

The initial periodic inspection performed under the purview of ER 1110-2-100 was conducted on 22 July 1970, six months after topping-out of the embankment and prior to intentional impoundment. As a result of that inspection the installation of ten additional surface settlement pipes was recommended and adopted.

In accordance with the inspection recommended in Design Memorandum No. 17, Instrumentation, and Periodic Report No. 1 for Beltzville Lake, the second periodic inspection was conducted on 22 July 1971, approximately six months after initiation of impoundment. Pool elevation at the time of the inspection was 602, twenty-six feet below water supply pool. The second periodic inspection team suggested a crack survey be performed on the spill way slab, a crack survey as performed after the initial inspection be duplicated to note changes, a weir be installed to measure seepage downstream of the embankment, and several erosion problems and minor deficiencies be corrected.

The third periodic inspection was conducted on 14 and 15 September 1972 due to a postponment generated by tropical storm "Agnes". The major area of concern to the third inspection party was seepage located downstream of the embankment. Installation of two additional weirs and a study of the seepage were requested.

The fourth periodic inspection was performed on 23-24 August 1972. Since the third periodic inspection report had not been submitted due to the emergency workload and subsequent manpower loss caused by "Agnes", it was requested that the third and fourth inspections be combined under one report. The major areas of concern to the fourth inspection party were,

observation and continued monitoring of seepage, correction of minor erosion problems, and monitoring of the instrumentation. The weir records show no increases in base flows thus indicating a stabilized seepage flow which is of minimal volume and does not represent a major concern. Monitoring the weir flows will continue.

The instrumentation installed to date appears to be adequately measuring the performance of the dam during the operational phase. Two pressure cells, which are presently inoperative, will be replaced by open-type piezometers. The spillway service bridge will be monitored in accordance with the tower bridge instrumentation program.

The overall condition of the project is considered excellent. Minor remedial work, as necessary, will be accomplished by routine maintenance and as funds become available on more significant items. The fifth recommended periodic inspection is presently scheduled for August 1974.


RELOCATED HIGHWAY
(TWP ROAD T-397)
OPERATIONS BLDG. AND
OVERLOOK STRUCTURE
CONCRETE CONTROL
STRUCTURE
ACCESS
ROAD
CONCRETE WALL
TOE OF DIKE
STA. 14+03.59
AXIS OF EMBANKMENT
TOE OF EMBANKMENT
INTAKE TOWER
APPROACH
CHANNEL
STALLING
POHOPOCO CREEK

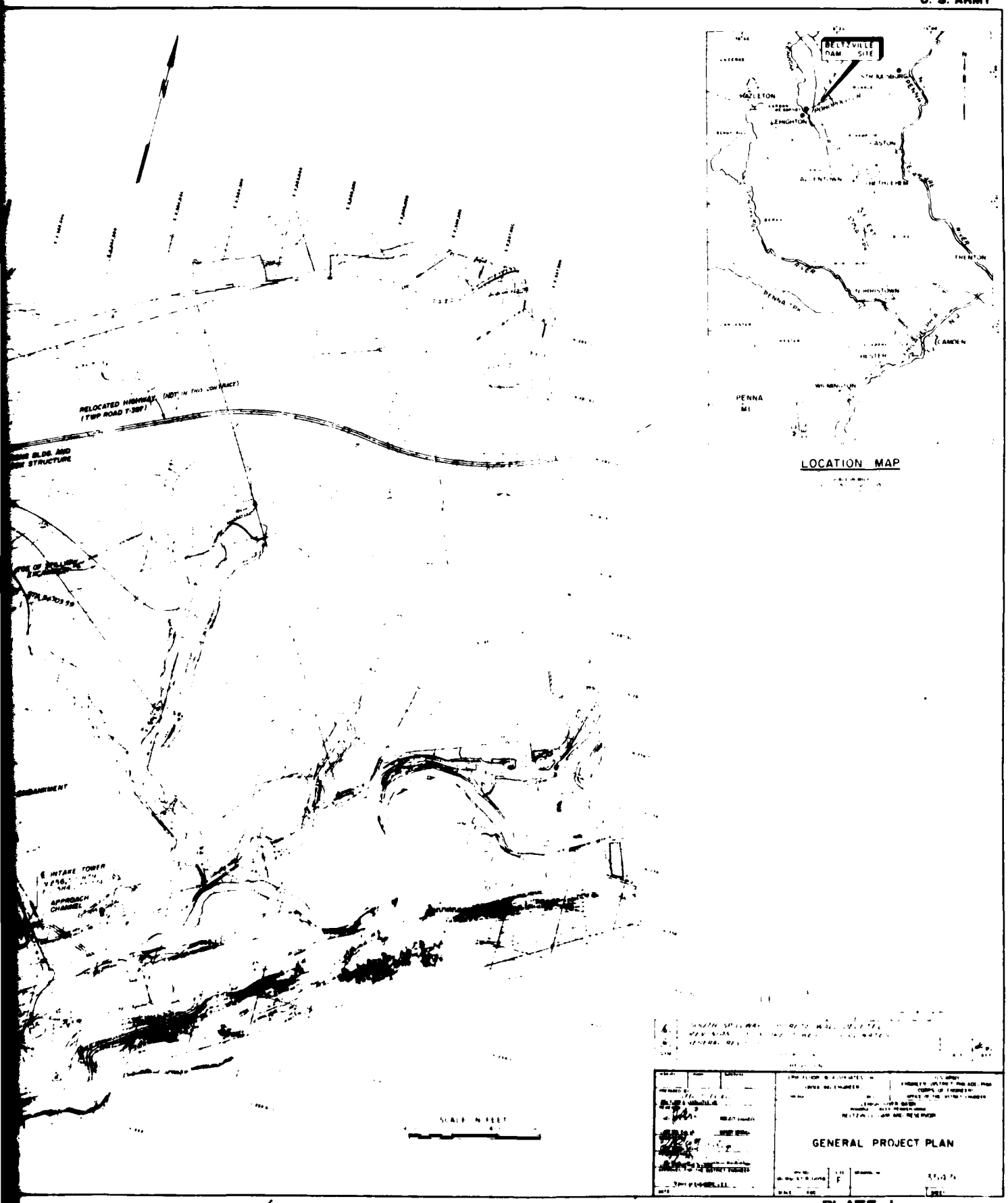
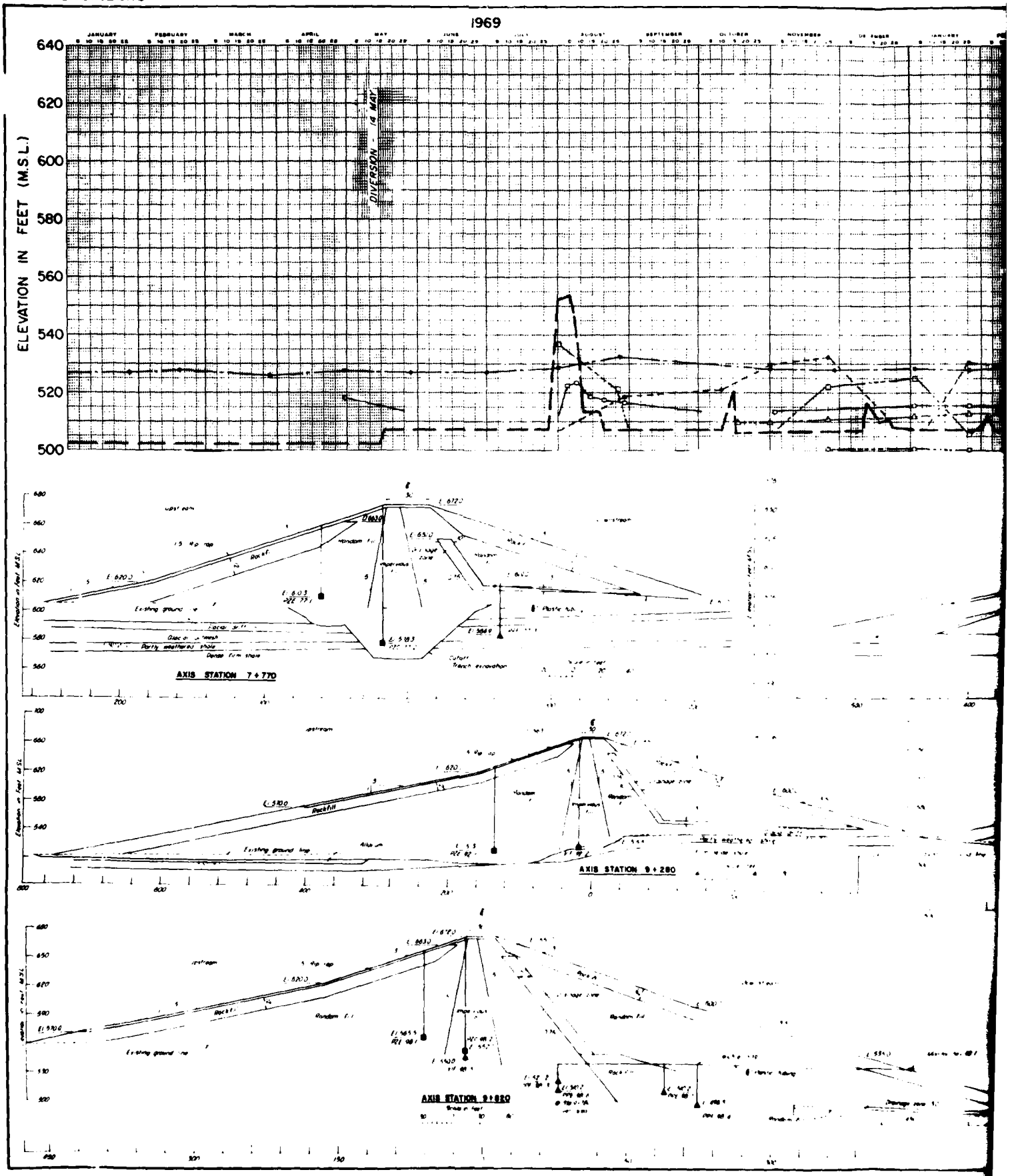
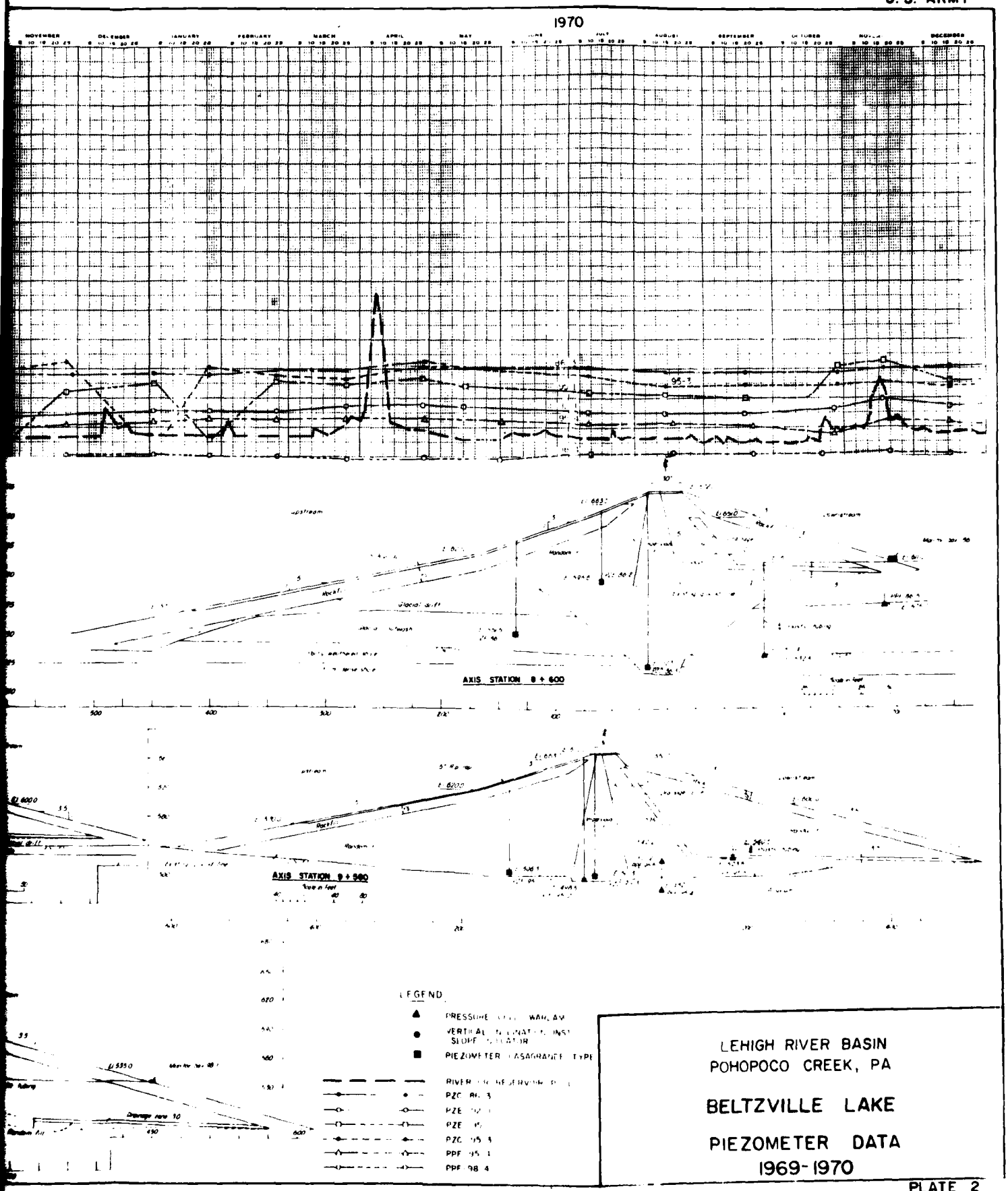

BELTZVILLE DAM SITE
HAZLETON
LEHIGHTON
EASTON
ALLENTOWN
BETHLEHEM
TRENTON
PENNA
CAMDEN
WILMINGTON
PENNA
MI
LOCATION MAP
RELOCATED HIGHWAY (NOT IN THIS CONTRACT)
(TWP ROAD T-339)
INTAKE TOWER
APPROACH CHANNEL
SCALE IN FEET
GENERAL PROJECT PLAN

PLATE I

CORPS OF ENGINEERS



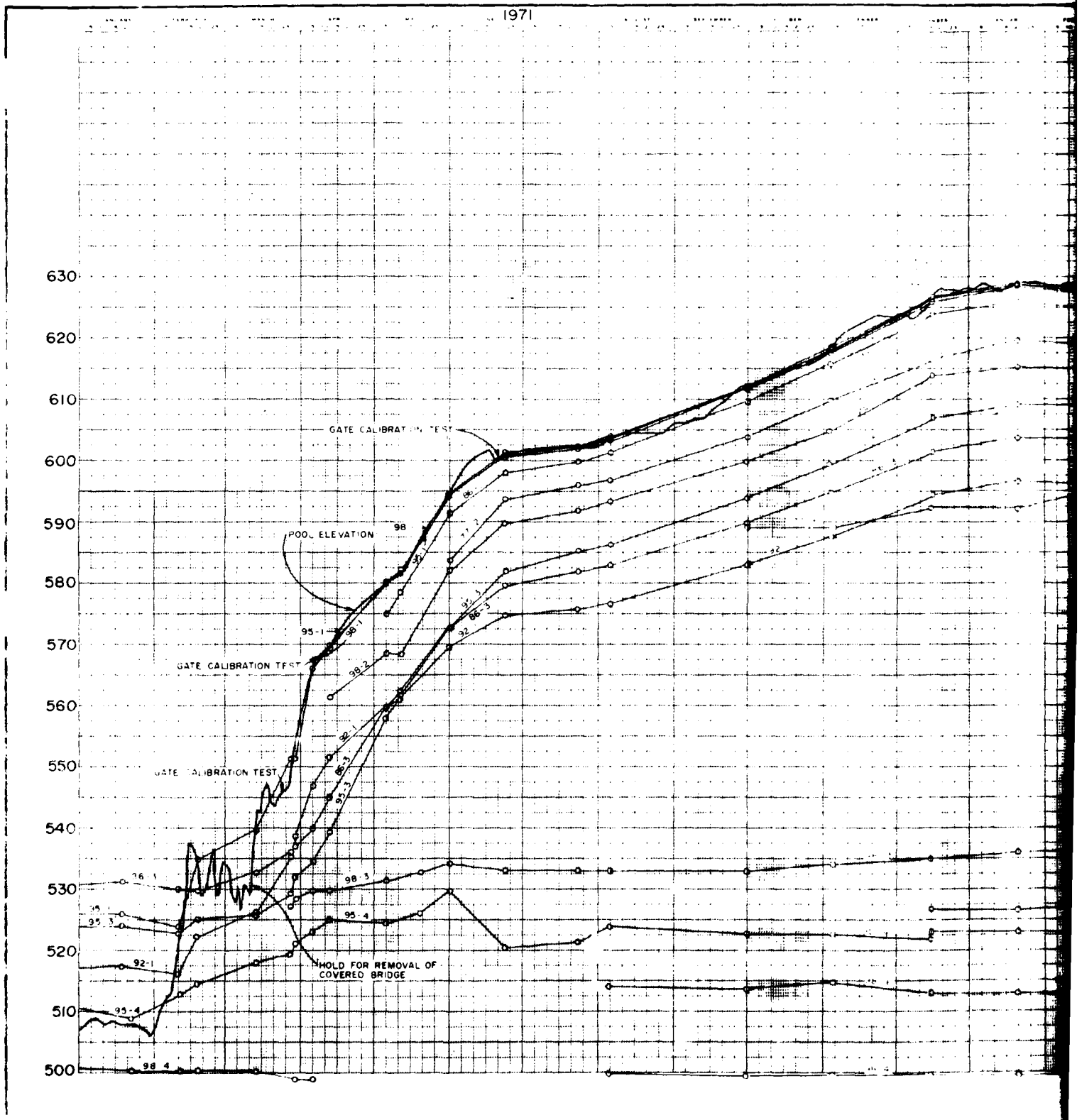



LEHIGH RIVER BASIN
POHOPOCO CREEK, PA

BELTZVILLE LAKE

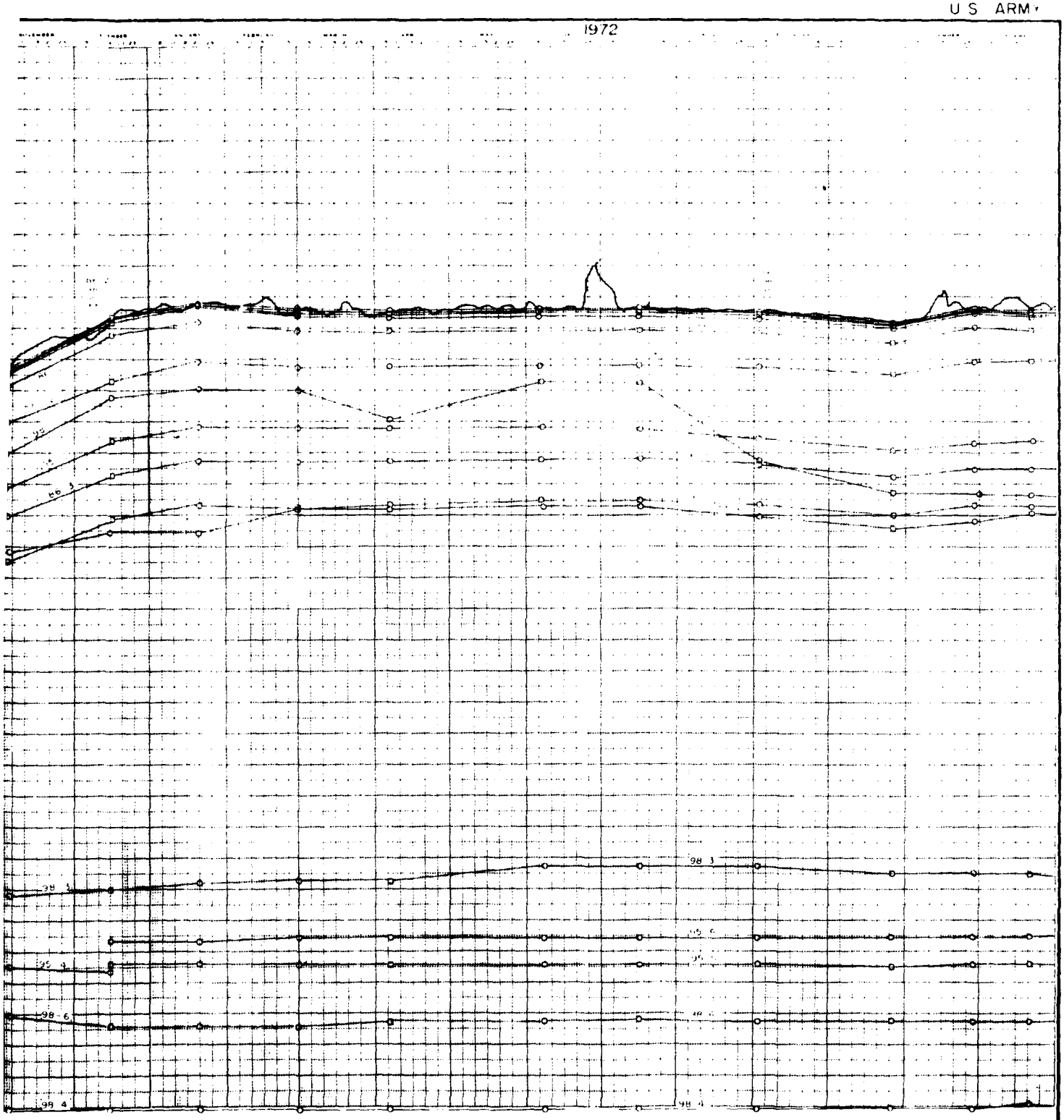
PIEZOMETER DATA
1969-1970

CORPS OF ENGINEERS




NOTES

Piezometer No 95-4 becam



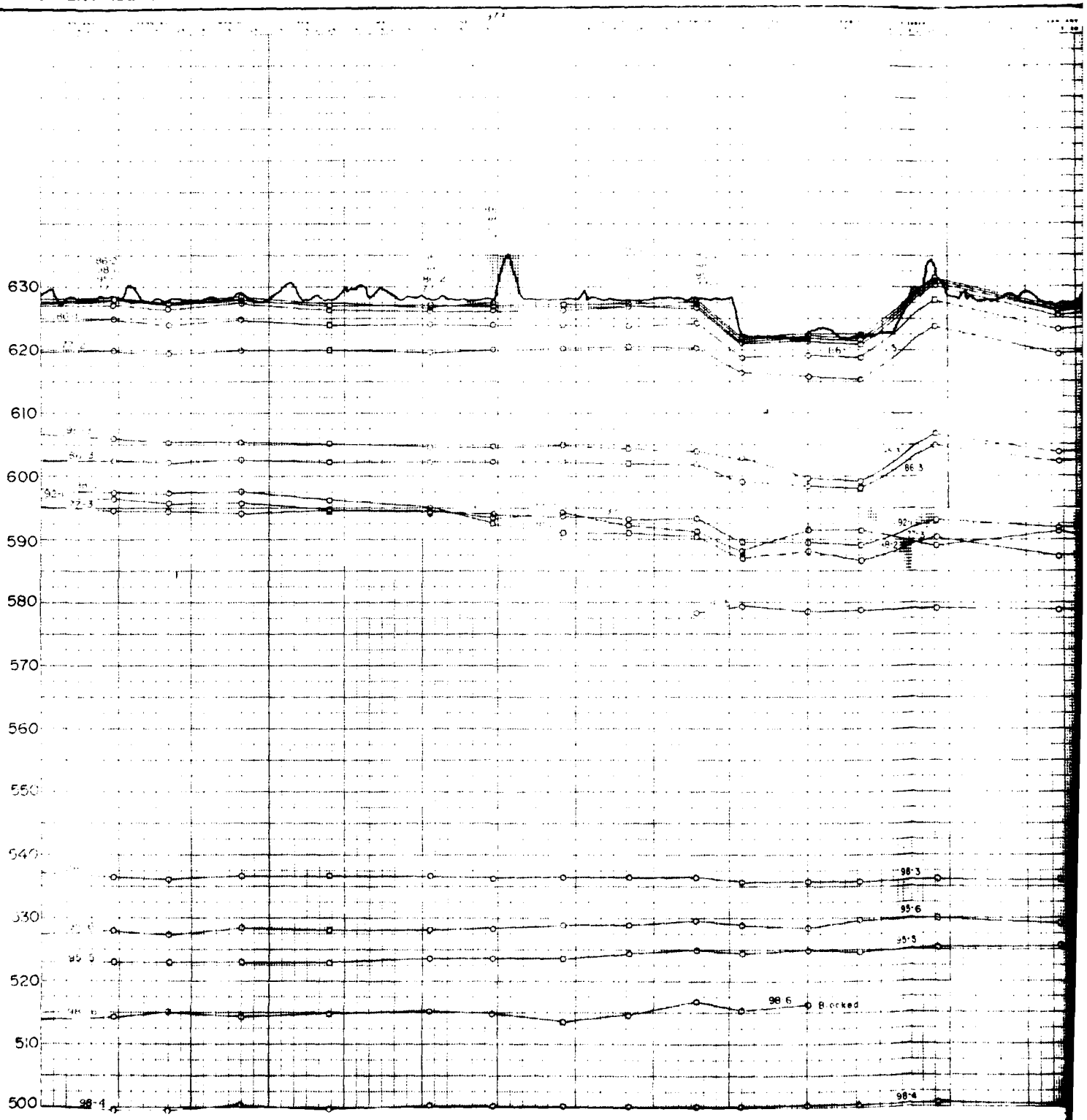

NOTES

Piezometer No. 95-4 became inoperative after 15 Dec 1971

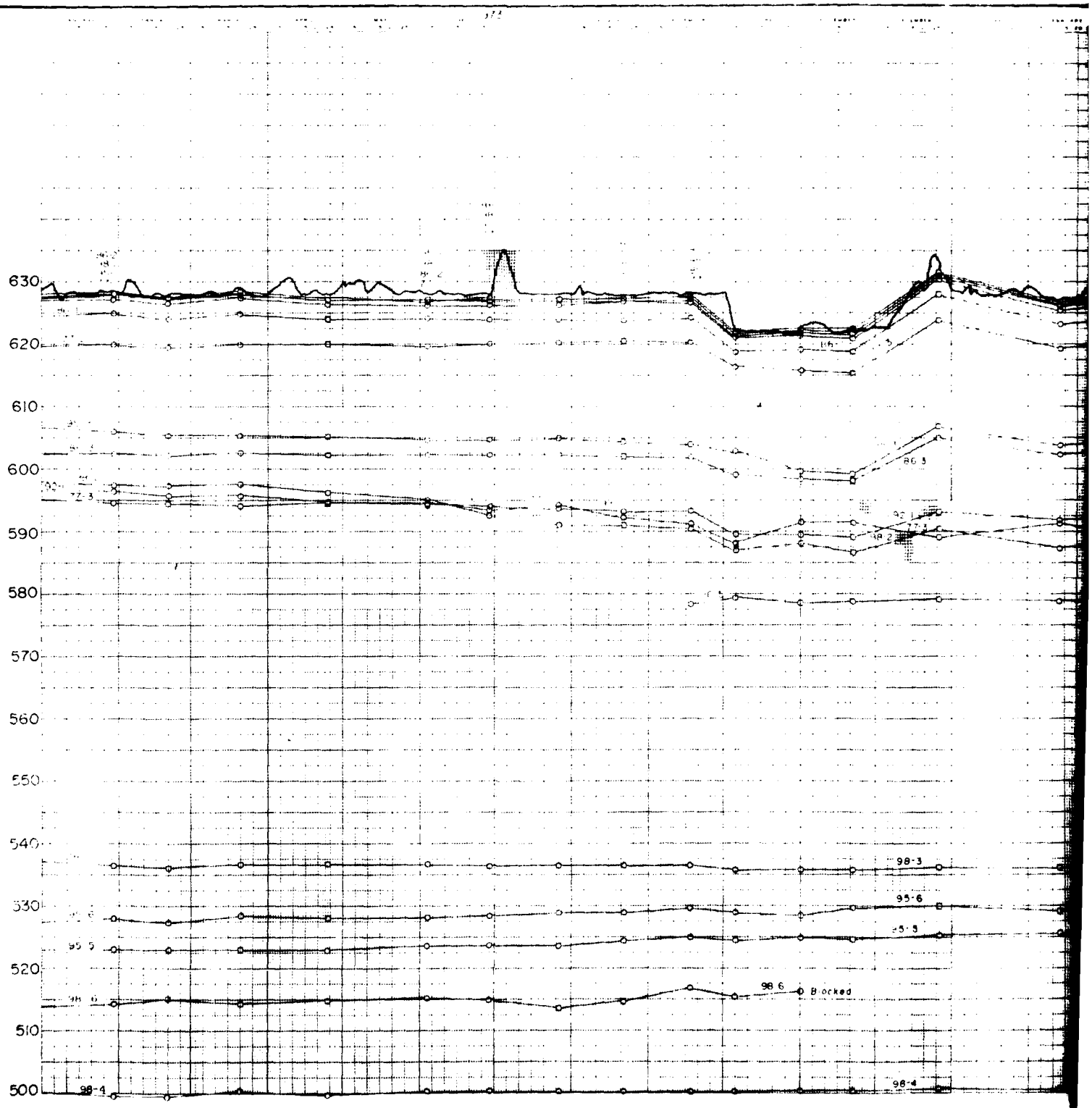
LEHIGH RIVER BASIN
POHOPOCO CREEK, PA
BELTZVILLE LAKE

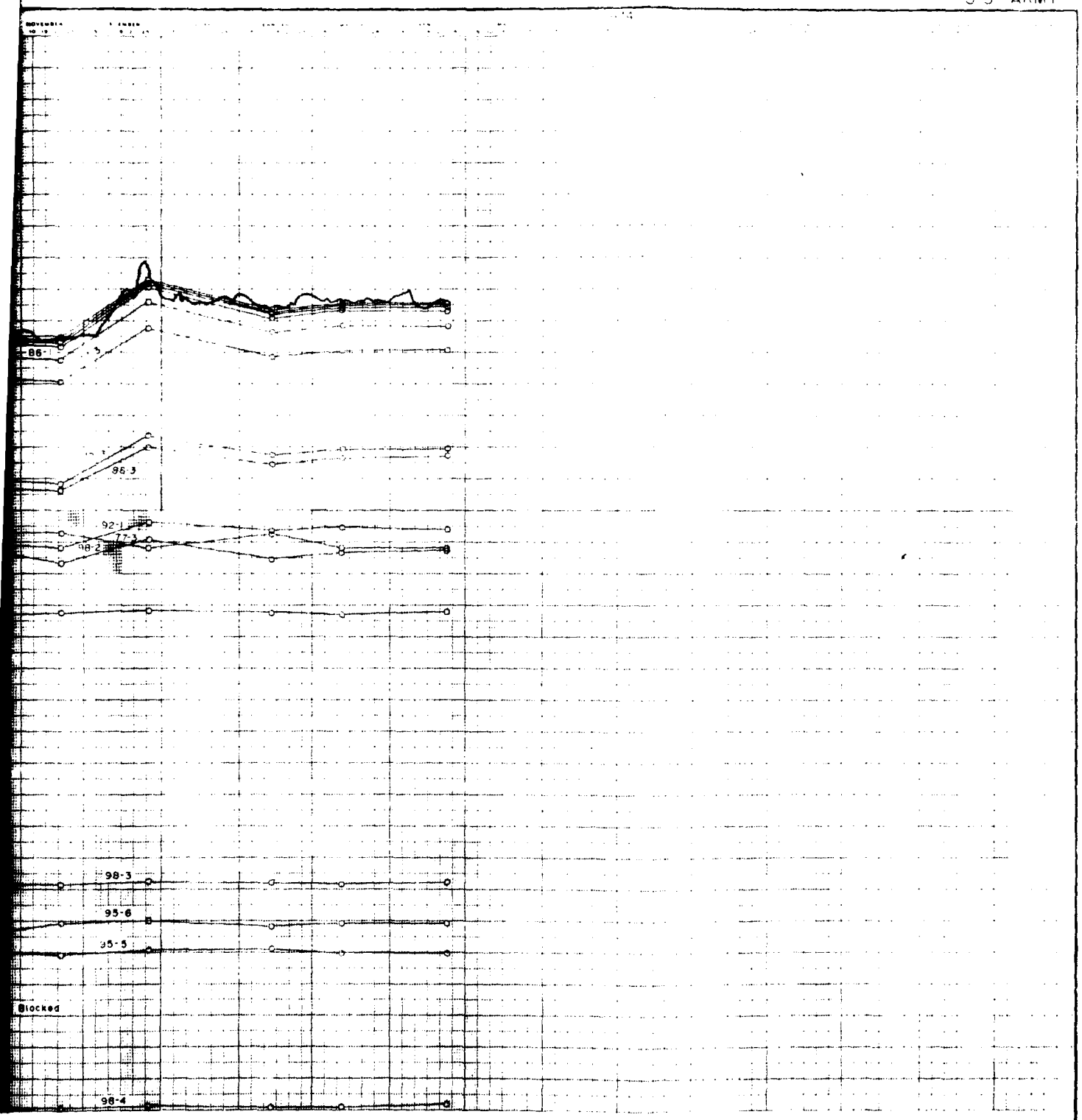
PIEZOMETER DATA
1971 – 1972

CORPS OF ENGINEERS



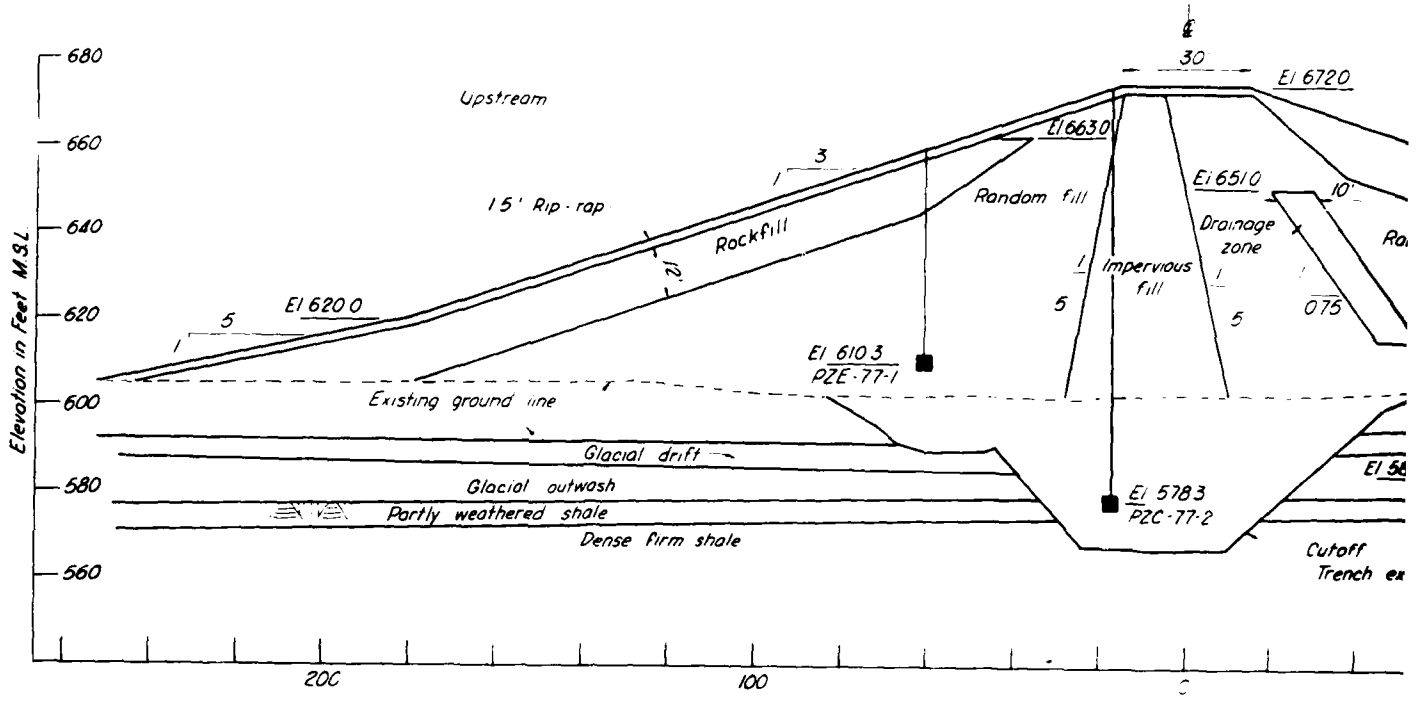
CORPS OF ENGINEERS






LEHIGH RIVER BASIN
POHOPOCO CREEK, PA
BELTZVILLE LAKE

**PIEZOMETER DATA**
**1973-1974**



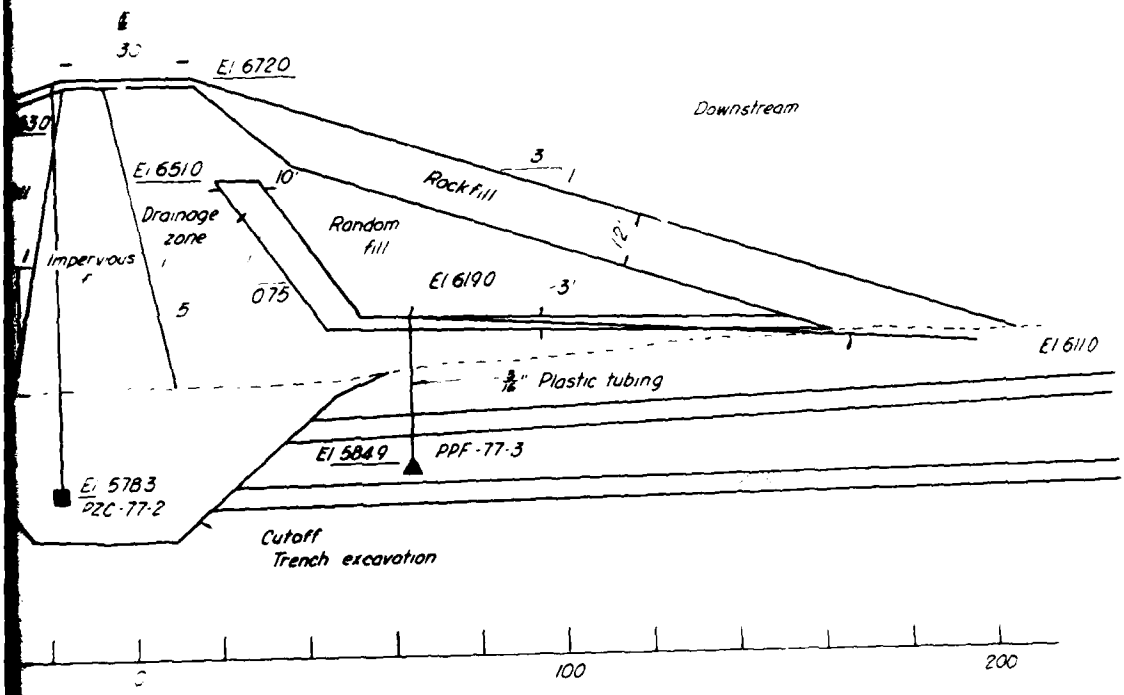

**AXIS STATION 7 + 770**

Scale in Feet

20 0 20 40

LEGEND

- ▲ Pressure cell
- ● Vertical inclination inst.
- ■ Piezometer
- PZC Piezometer - Cutoff trench
- PZE Piezometer - Embankment
- PZF Piezometer Foundation
- VIF Vertical incl. instrument - Foundation
- PCE Pressure cell: Embankment
- PCF Pressure cell - Foundation




**STATION 7 + 770**

Scale in Feet
0 20 40

cell
inclination inst
- Cutoff trench
- Embankment
- Foundation
incl instrument - Foundation
cell Embankment
cell Foundation

| REVISIONS | | | |
|---|---|---|---|
| SYM. | DESCRIPTION | DATE | APPD |
| | | | |
| | | | |

LEHIGH RIVER BASIN

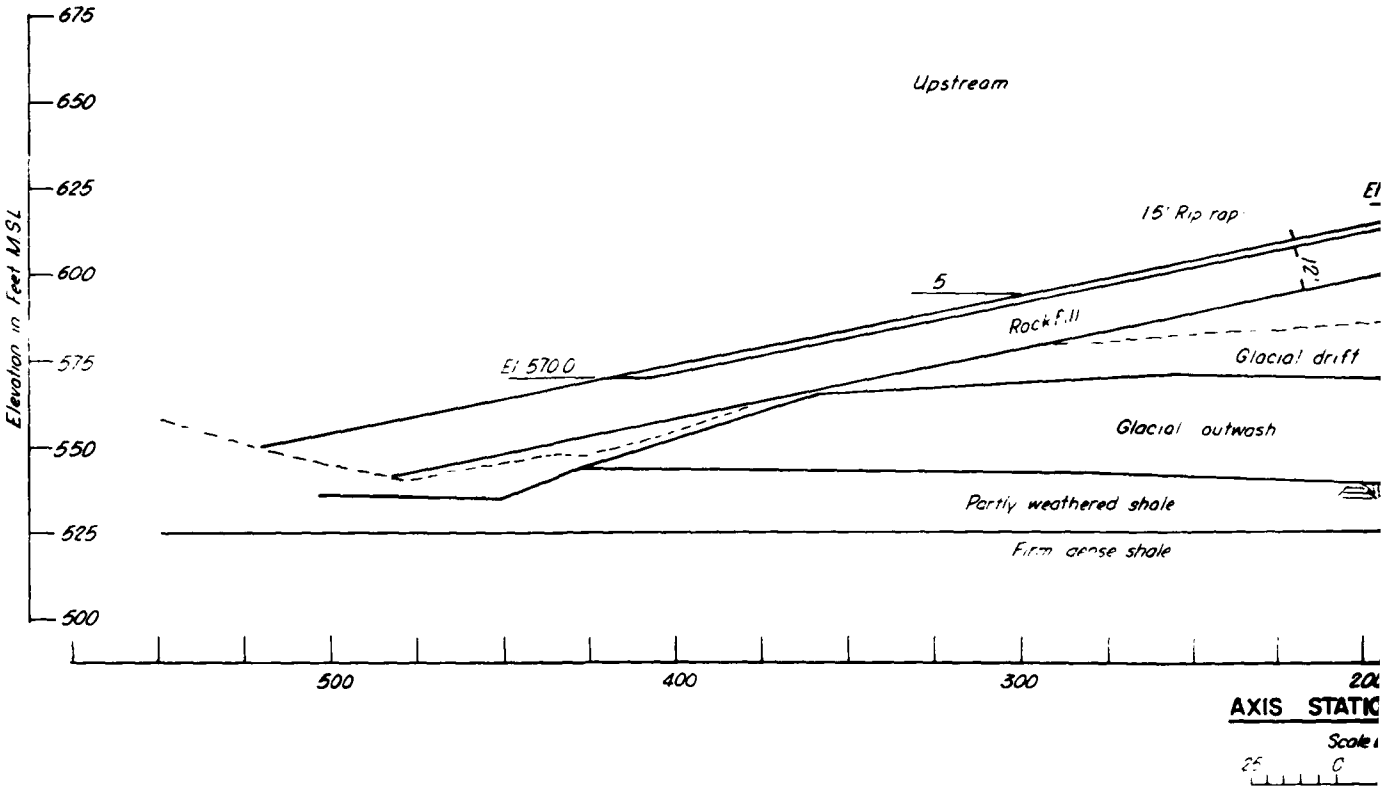
BELTZVILLE LAKE

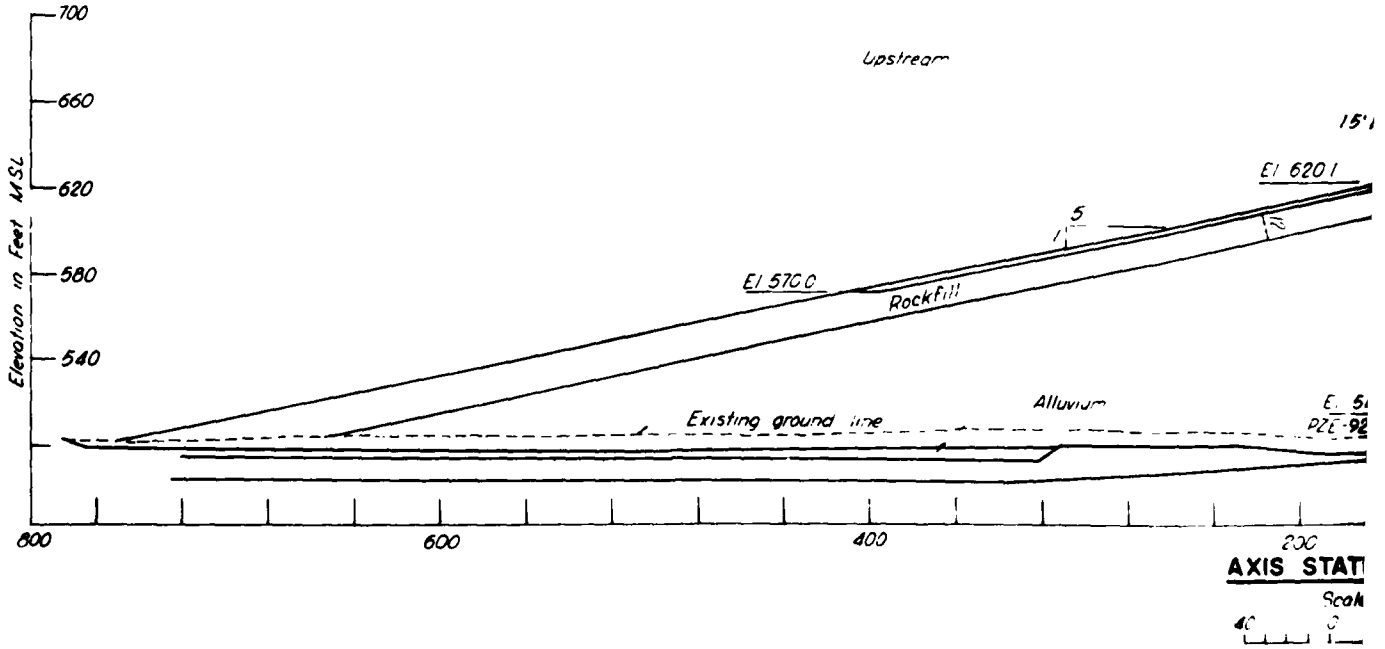
POHOPOCO CREEK, PENNSYLVANIA

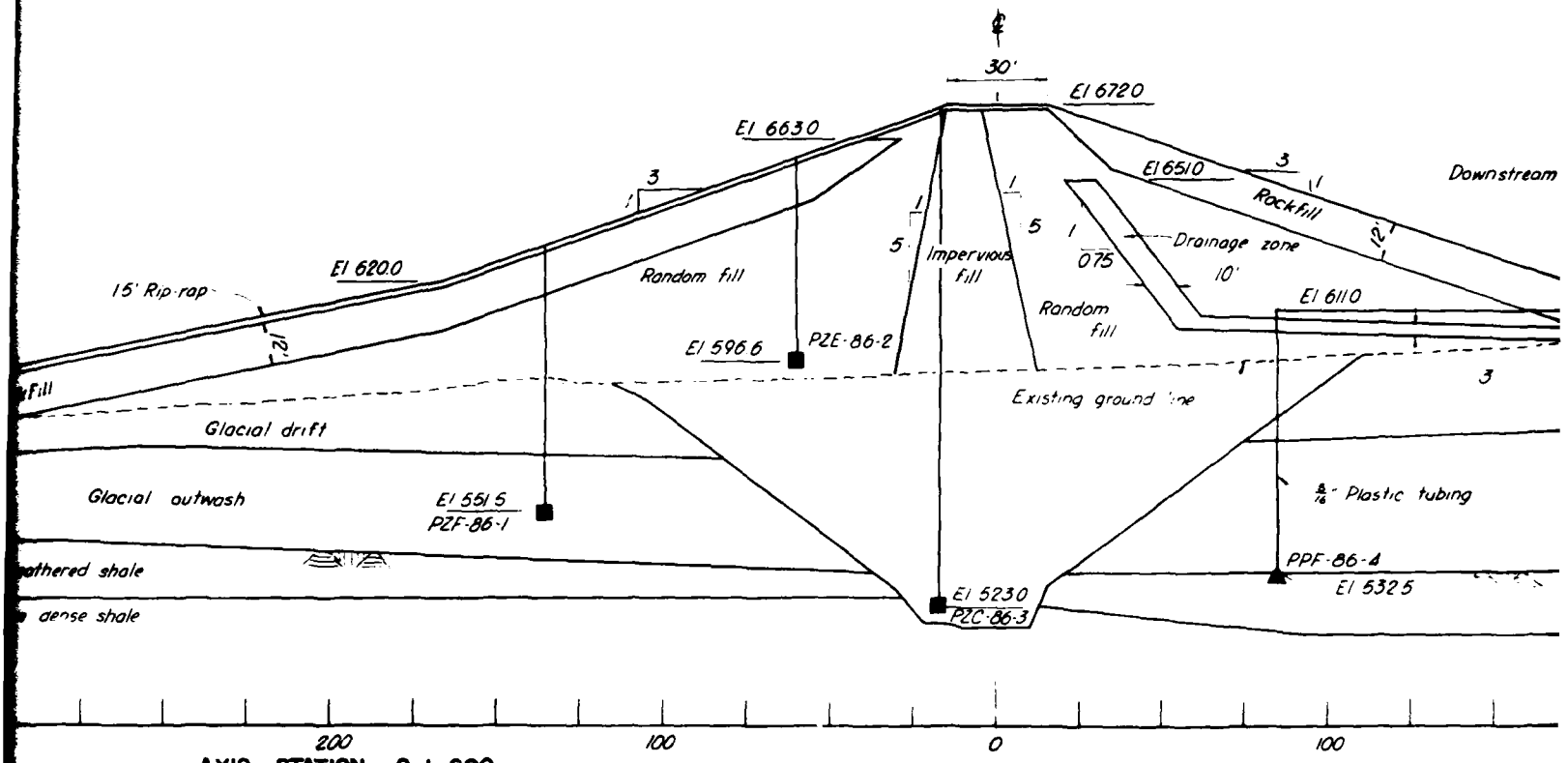
**INSTRUMENTATION LINE**

**STATION 7+770**

PLATE 5


675
650
625
600
575
550
525
500
Elevation in Feet MSL
Upstream
15' Rip rap
5
Rock fill
El 570.0
Glacial drift
Glacial outwash
Partly weathered shale
Firm dense shale
500
400
300
AXIS STATIC

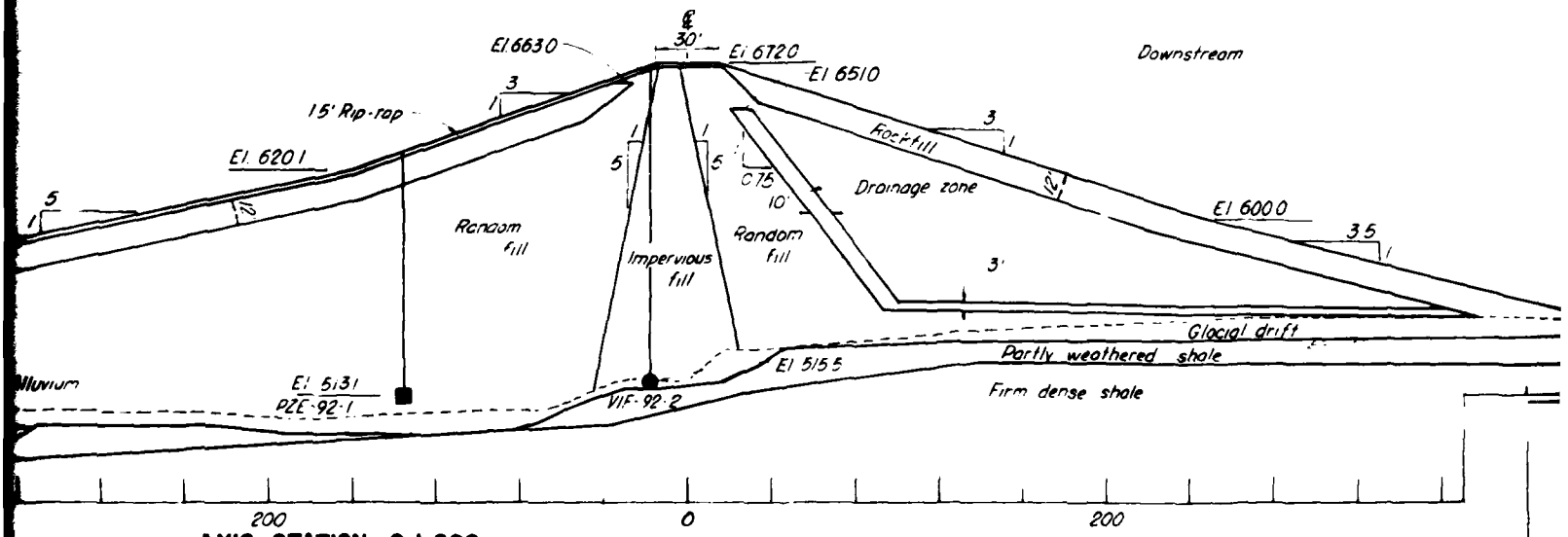

700
660
620
580
540
Elevation in Feet MSL
Upstream
El 620.1
5
El 570.0
Rockfill
Alluvium
Existing ground line
800
600
400
AXIS STAT




**AXIS STATION 8 + 600**

Scale in Feet

25 0 25 50

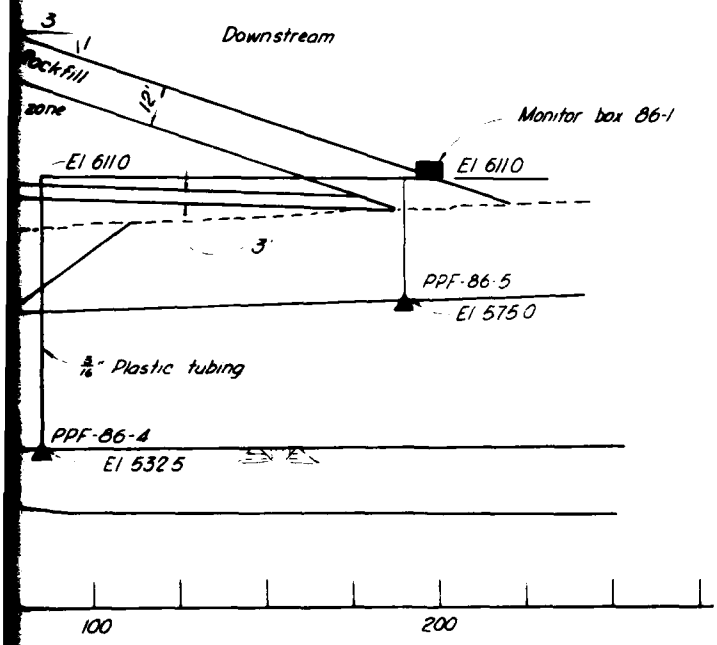


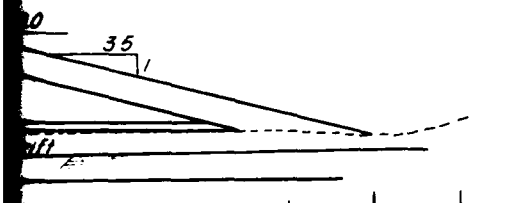

**AXIS STATION 9 + 280**

Scale in Feet

40 0 40 80

| REVISIONS | | | |
|---|---|---|---|
| SYM. | DESCRIPTION | DATE | APPD |
| | | | |
| | | | |




LEHIGH RIVER BASIN

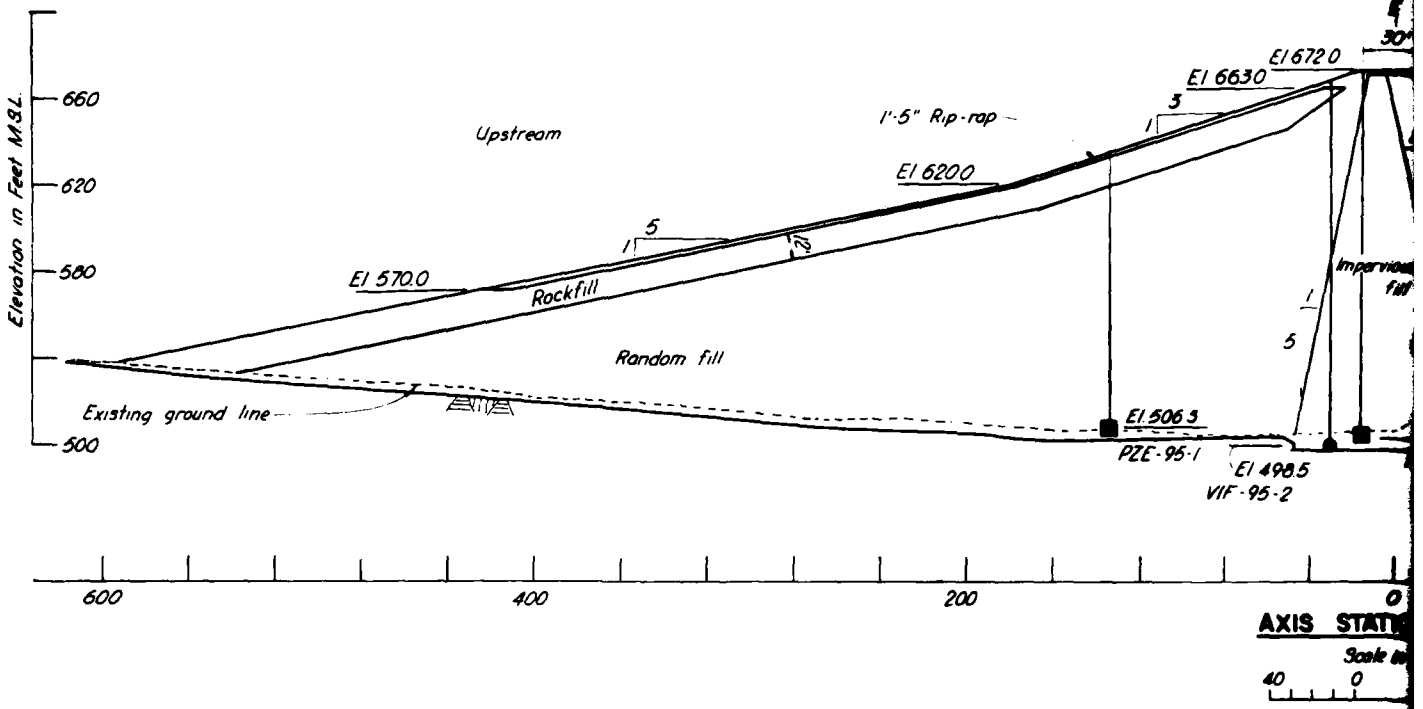
**BELTZVILLE LAKE**

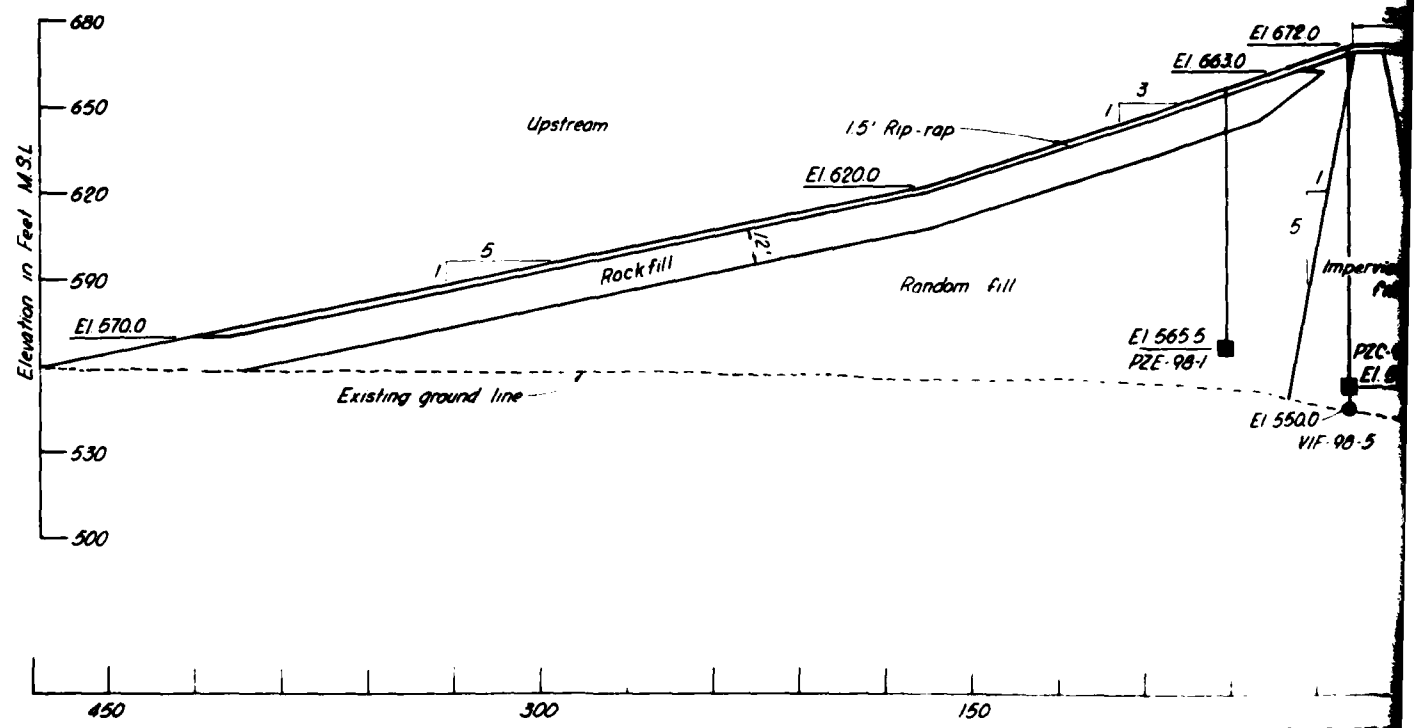
POHOPOCO CREEK, PENNSYLVANIA

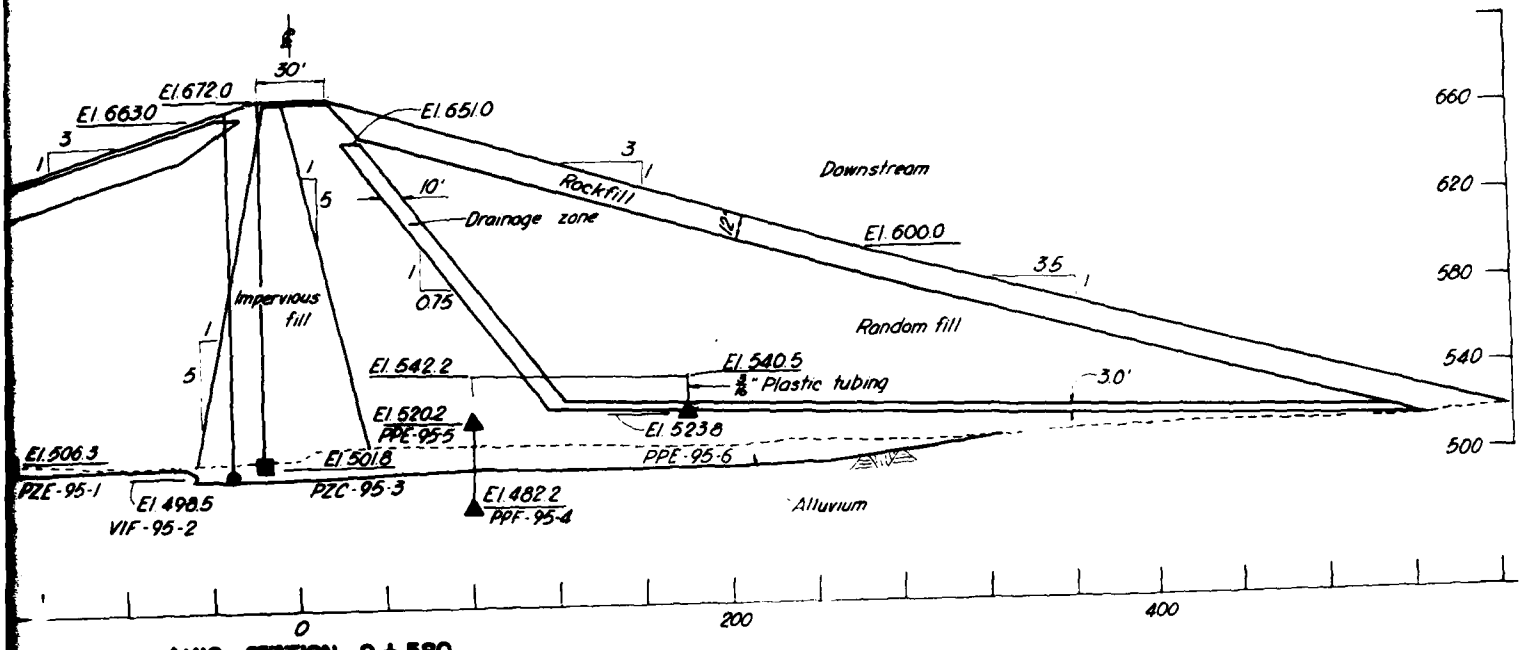
**INSTRUMENTATION LINE**

**STATION 8+600 & STATION 9+280**

**PLATE 6**


Elevation in Feet M.S.L.
660
620
580
500
Upstream
1'-5" Rip-rap
El 672.0
El 663.0
El 620.0
El 570.0
Rockfill
Random fill
Existing ground line
El 506.3
PZE-95-1
El 498.5
VIF-95-2
600
400
200
0
AXIS STAT

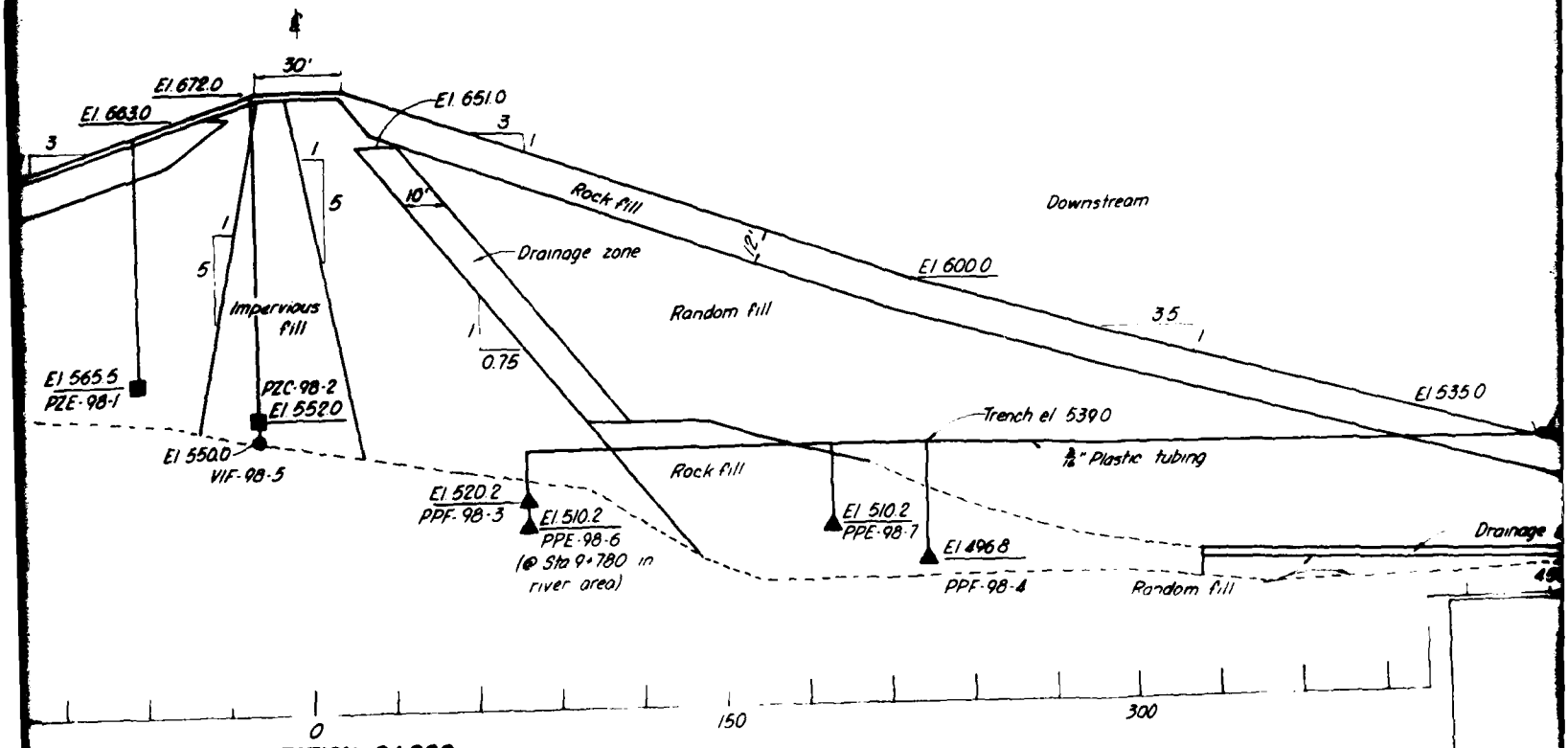

Elevation in Feet M.S.L.
680
650
620
590
530
500
Upstream
1.5' Rip-rap
El 672.0
El 663.0
El 620.0
El 570.0
Rockfill
Random fill
Existing ground line
El 565.5
PZE-98-1
El 550.0
VIF-98-5
450
300
150
AXIS STA




**AXIS STATION 9 + 580**

Scale in Feet

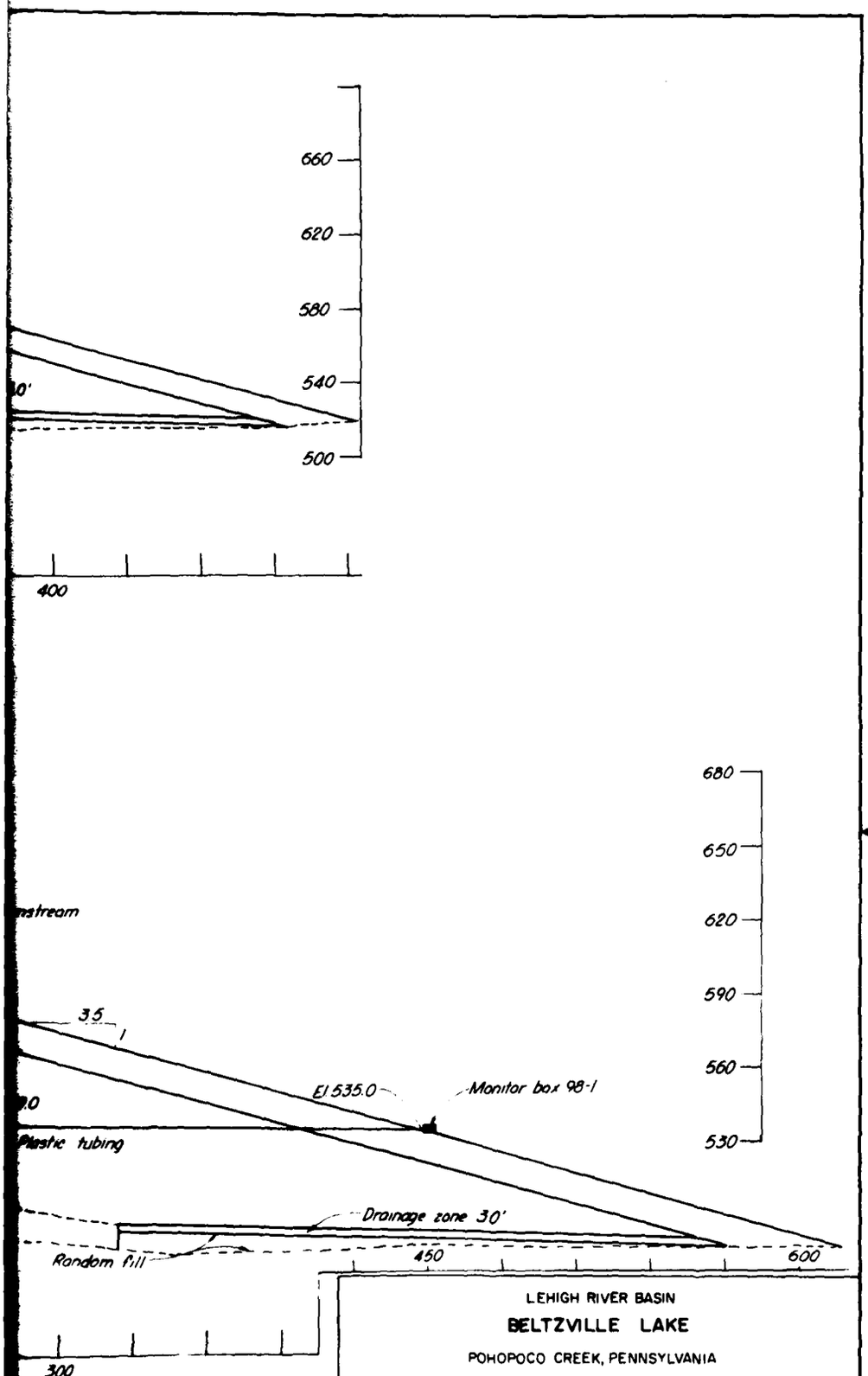
40 0 40 80




**AXIS STATION 9+820**

Scale in Feet

30 0 30 60




LEHIGH RIVER BASIN

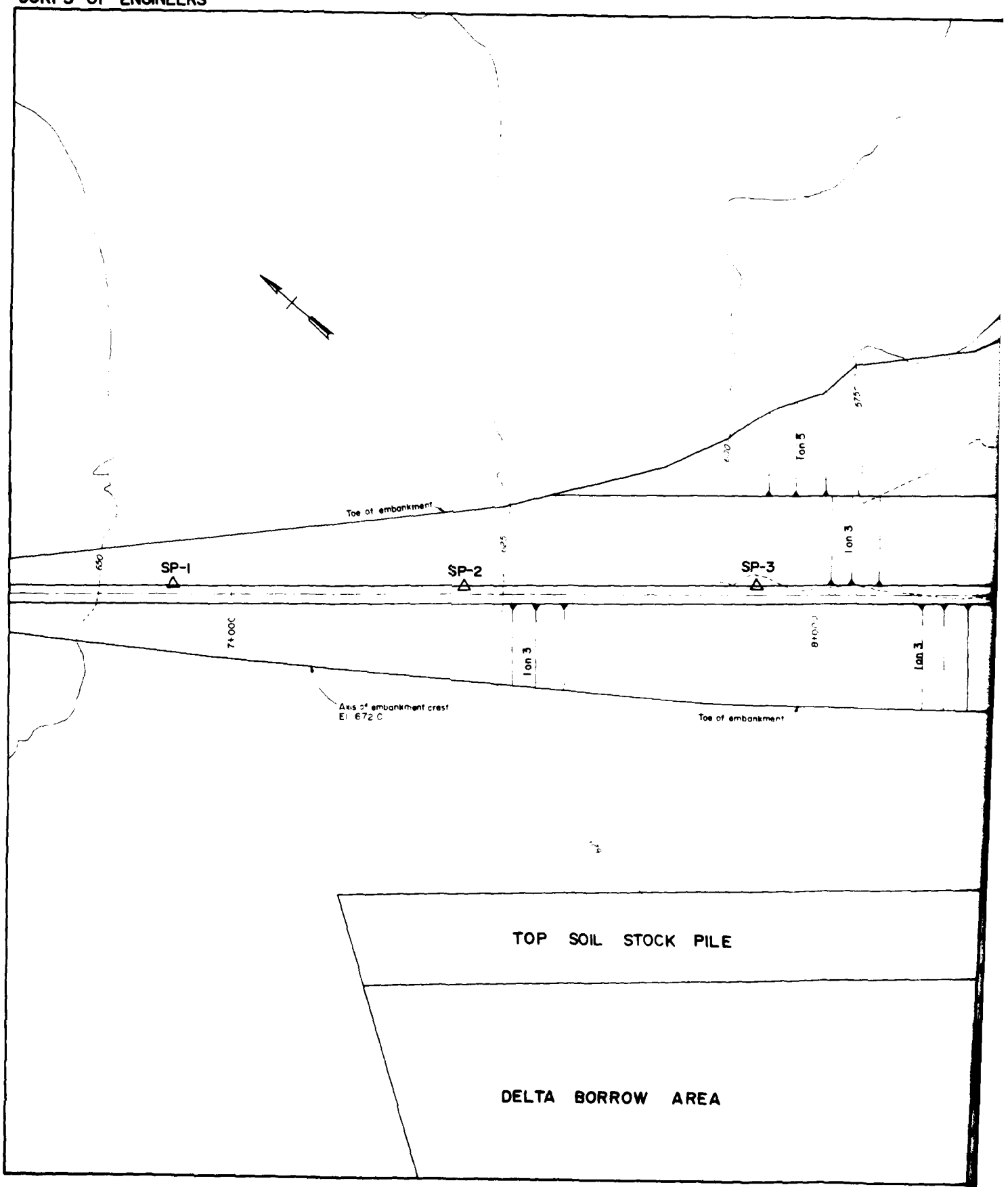
**BELTZVILLE LAKE**

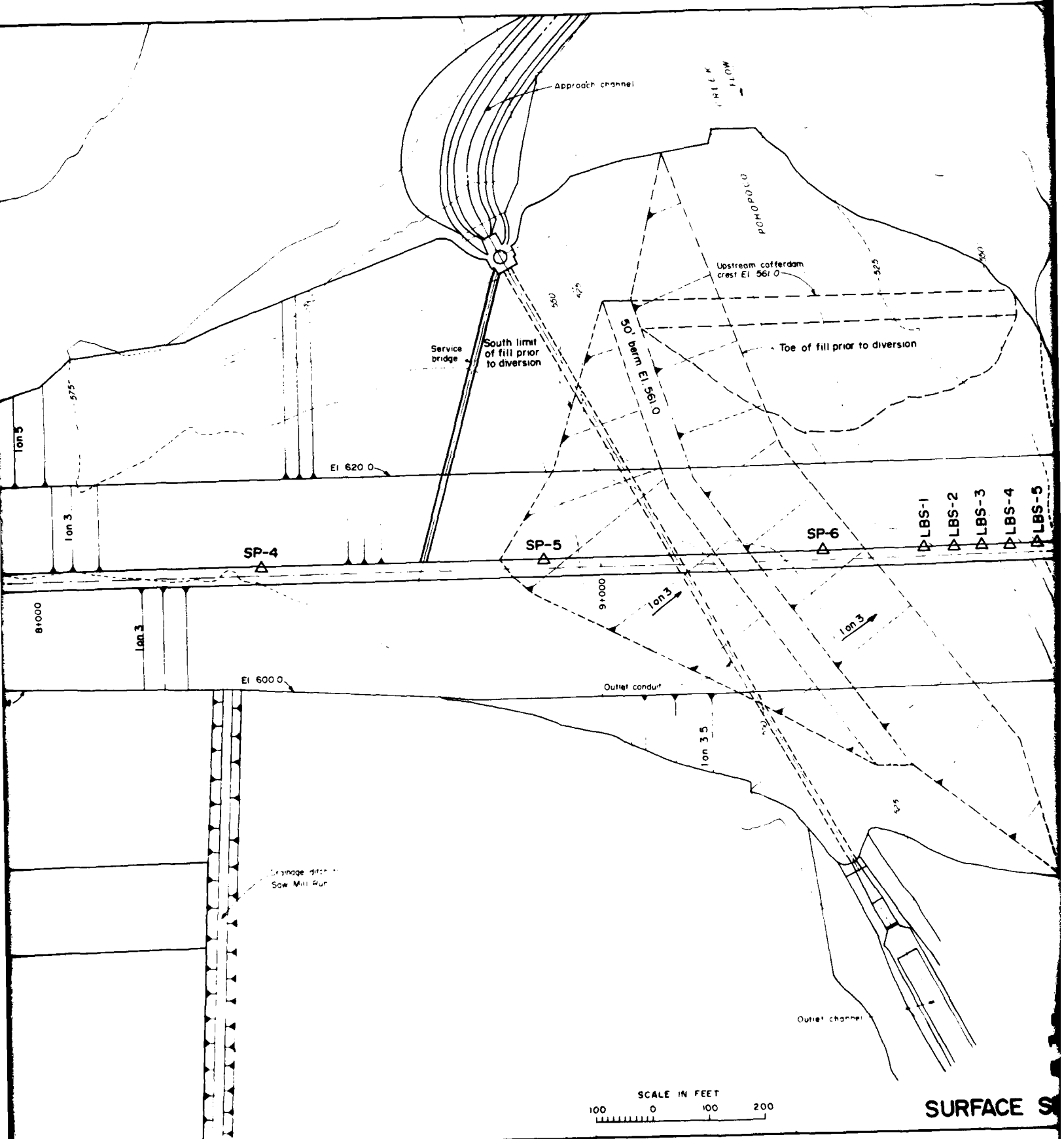
POHOPOCO CREEK, PENNSYLVANIA

**INSTRUMENTATION LINE**

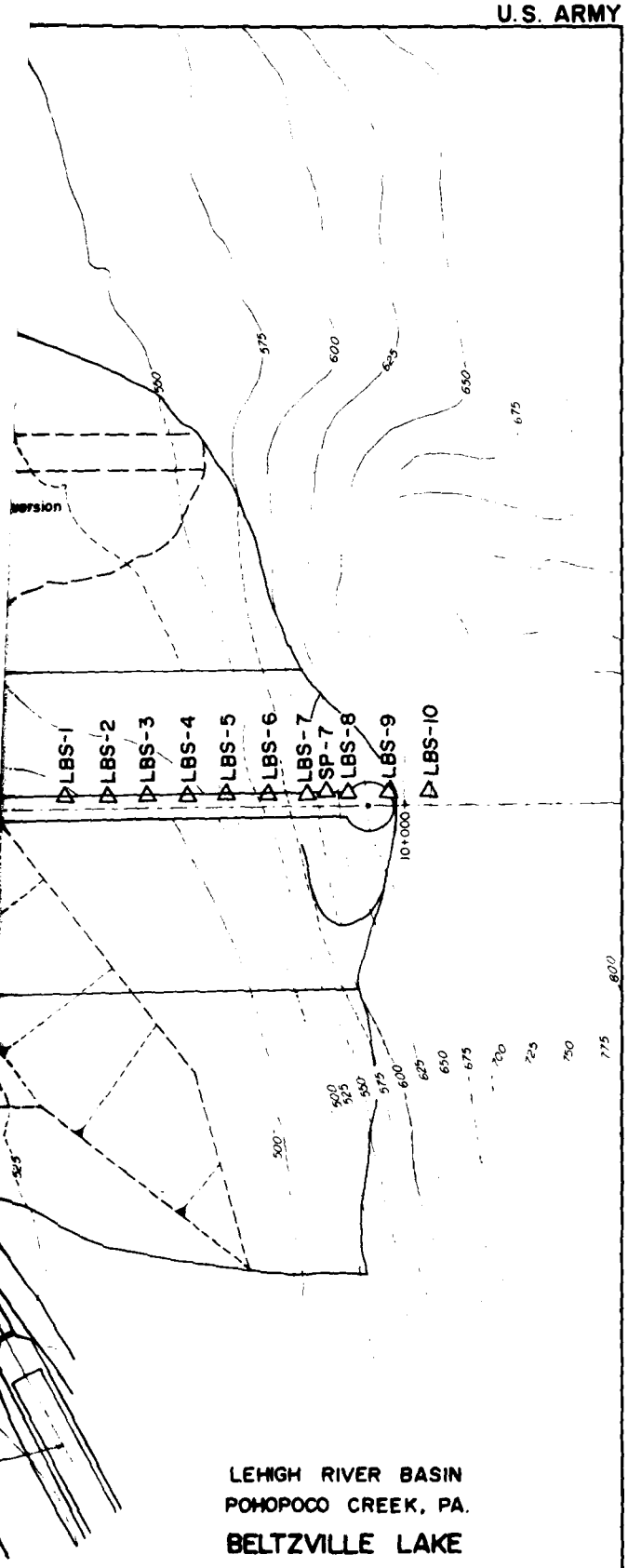
**STATION 9+580 & STATION 9+820**

CORPS OF ENGINEERS




Approach channel
POHOPOCO
Upstream cofferdam crest El 561.0
Toe of fill prior to diversion
50' berm El. 561.0
Service bridge
South limit of fill prior to diversion
El 620.0
1 on 5
1 on 3
SP-4
SP-5
SP-6
LBS-1
LBS-2
LBS-3
LBS-4
LBS-5
8+000
9+000
1 on 3
1 on 3
1 on 3
El 600.0
Outlet conduit
1 on 3.5
Drainage ditch
Saw Mill Run
Outlet channel
SCALE IN FEET
100 0 100 200
SURFACE S

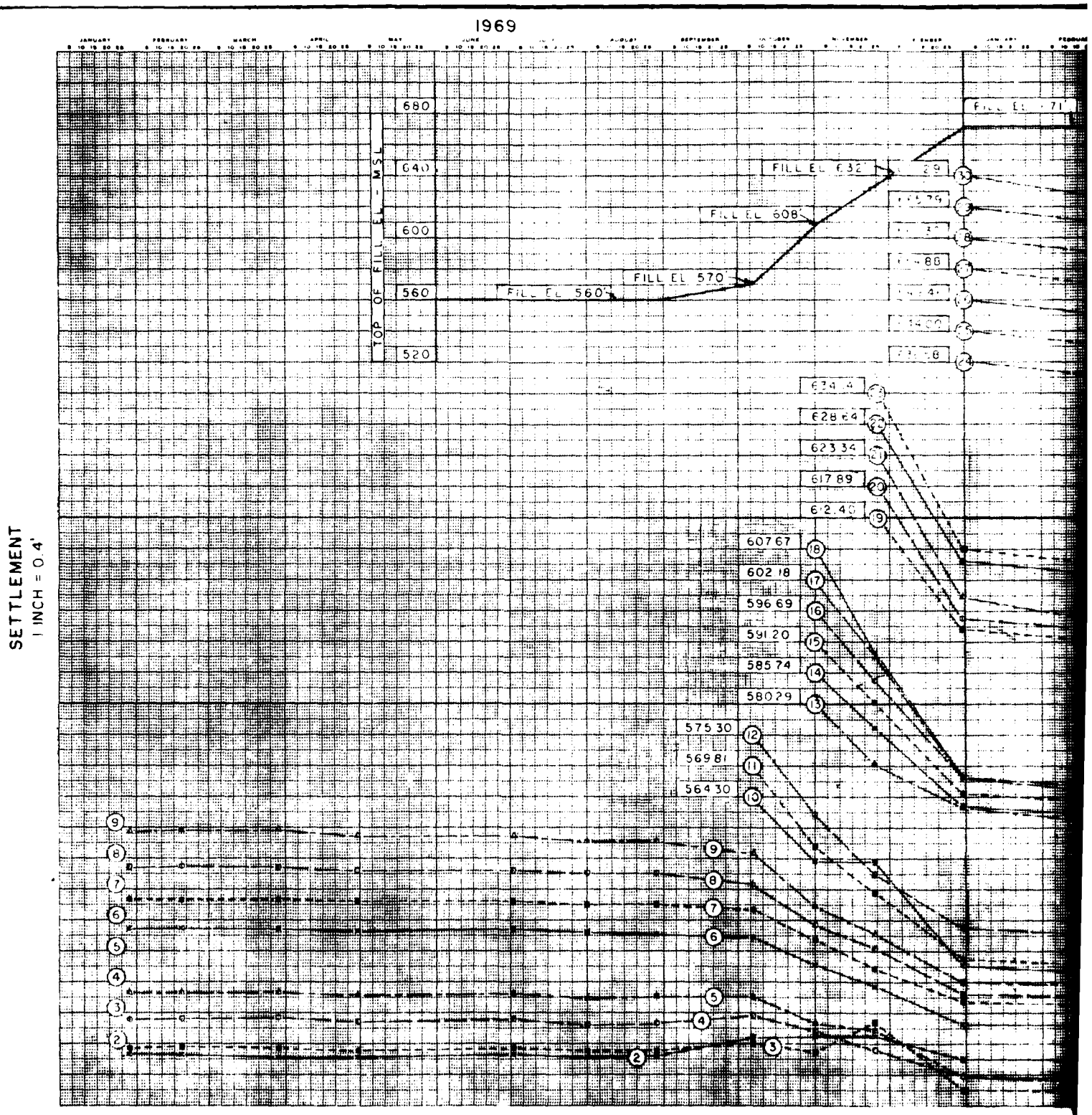
U.S. ARMY



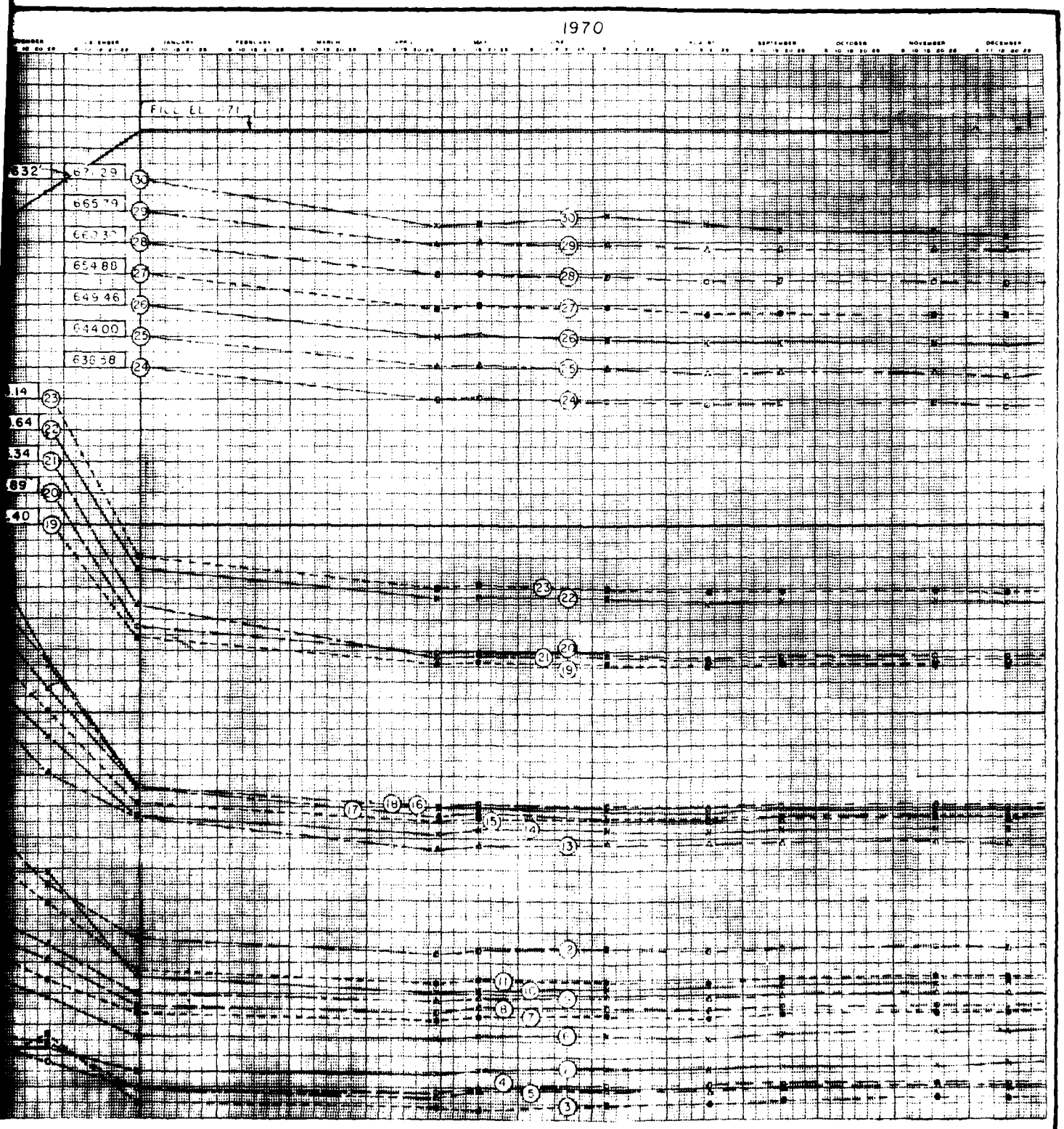

LEHIGH RIVER BASIN
POHOPOCO CREEK, PA.
BELTZVILLE LAKE

SURFACE SETTLEMENT PIPE PLAN

PLATE 8




NOTE
564.30
ELEVAT

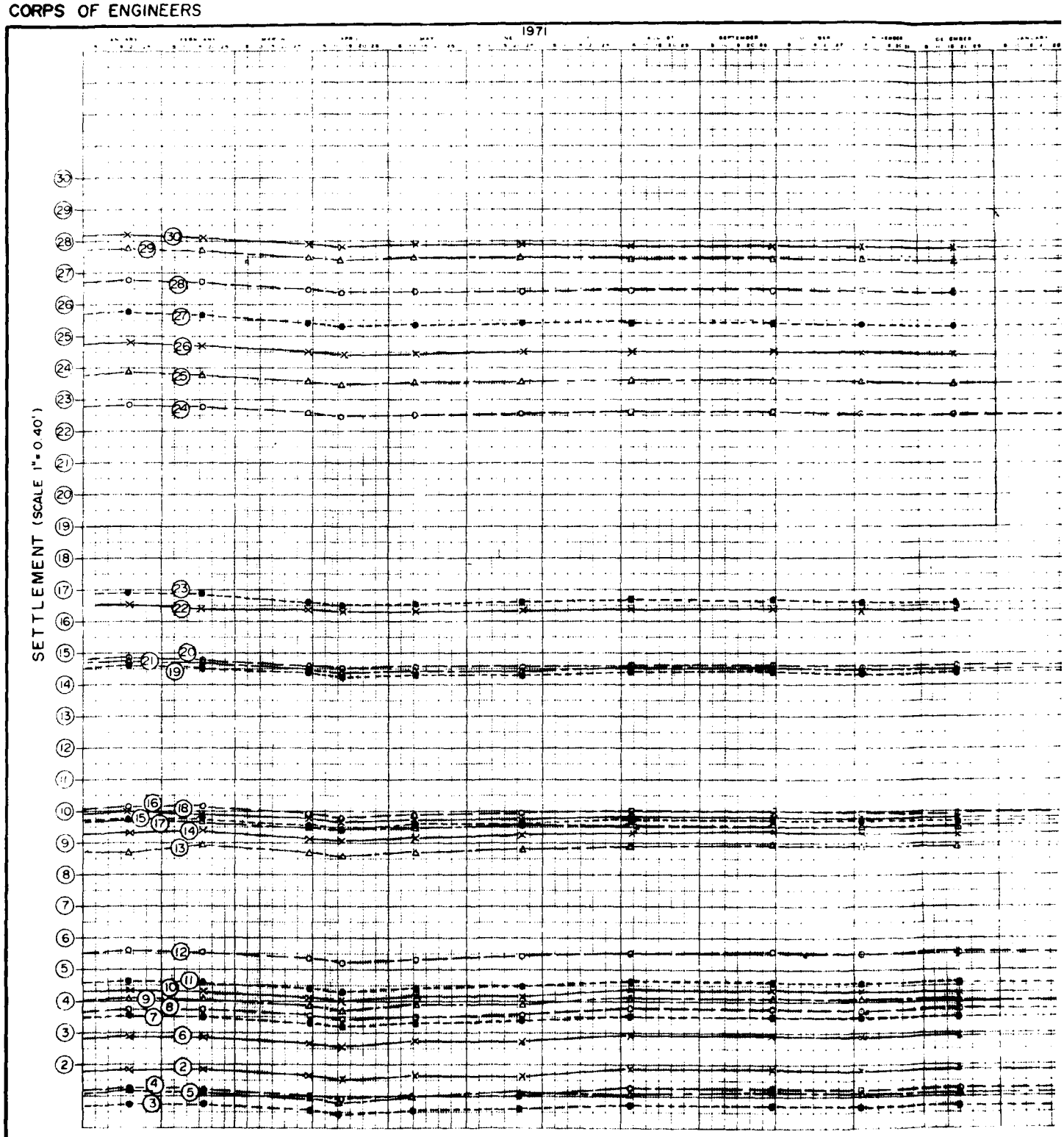



NOTE

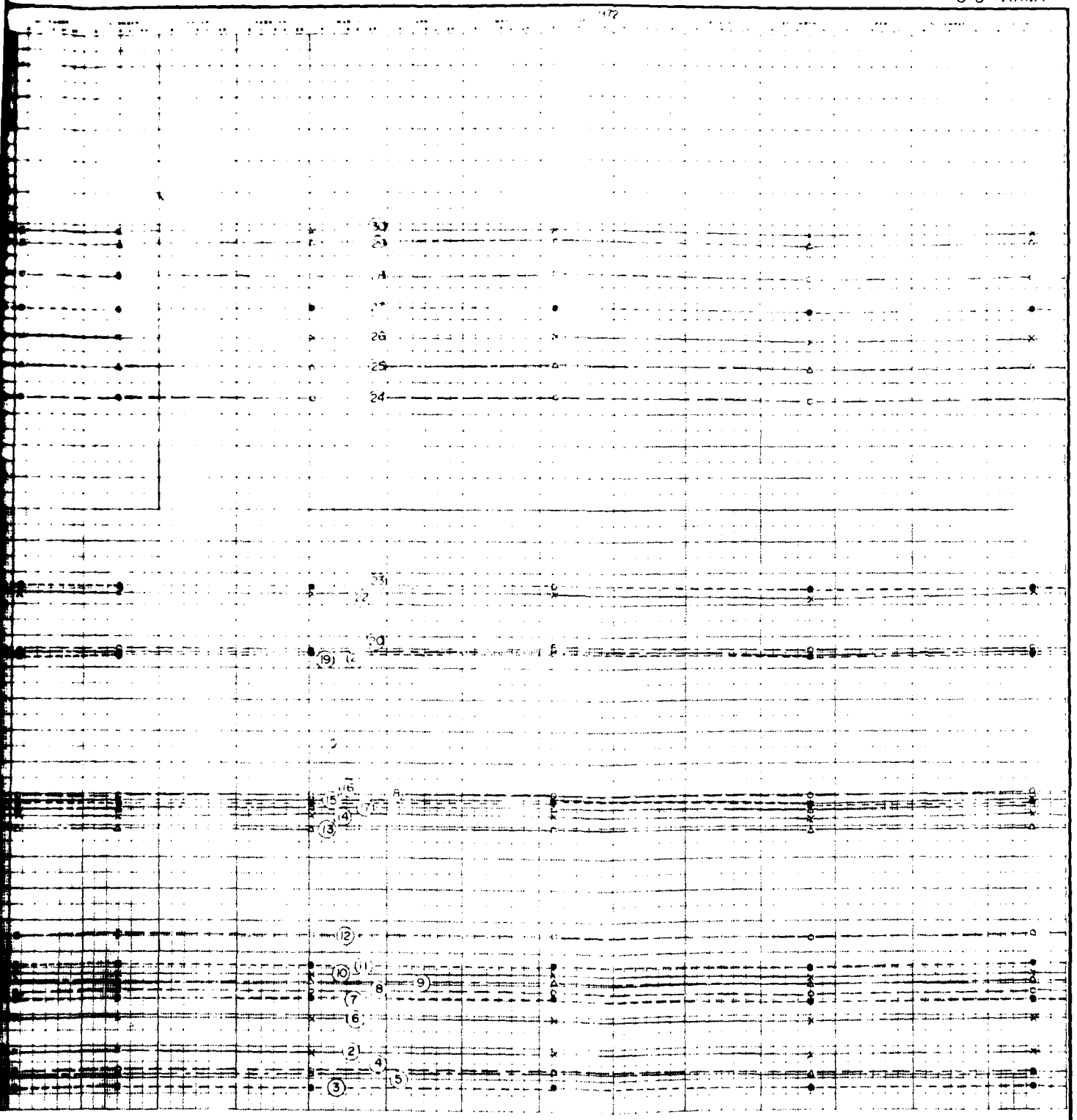
564 30 ⑩ = INITIALLY INSTALLED BOTTOM ELEVATION FOR CASING #10

LEHIGH RIVER BASIN
POHOPOCO CREEK, PA.
BELTZVILLE LAKE
**SUBSURFACE SETTLEMENT DATA**
VIF - 92 - 2 1969 - 1970

CORPS OF ENGINEERS



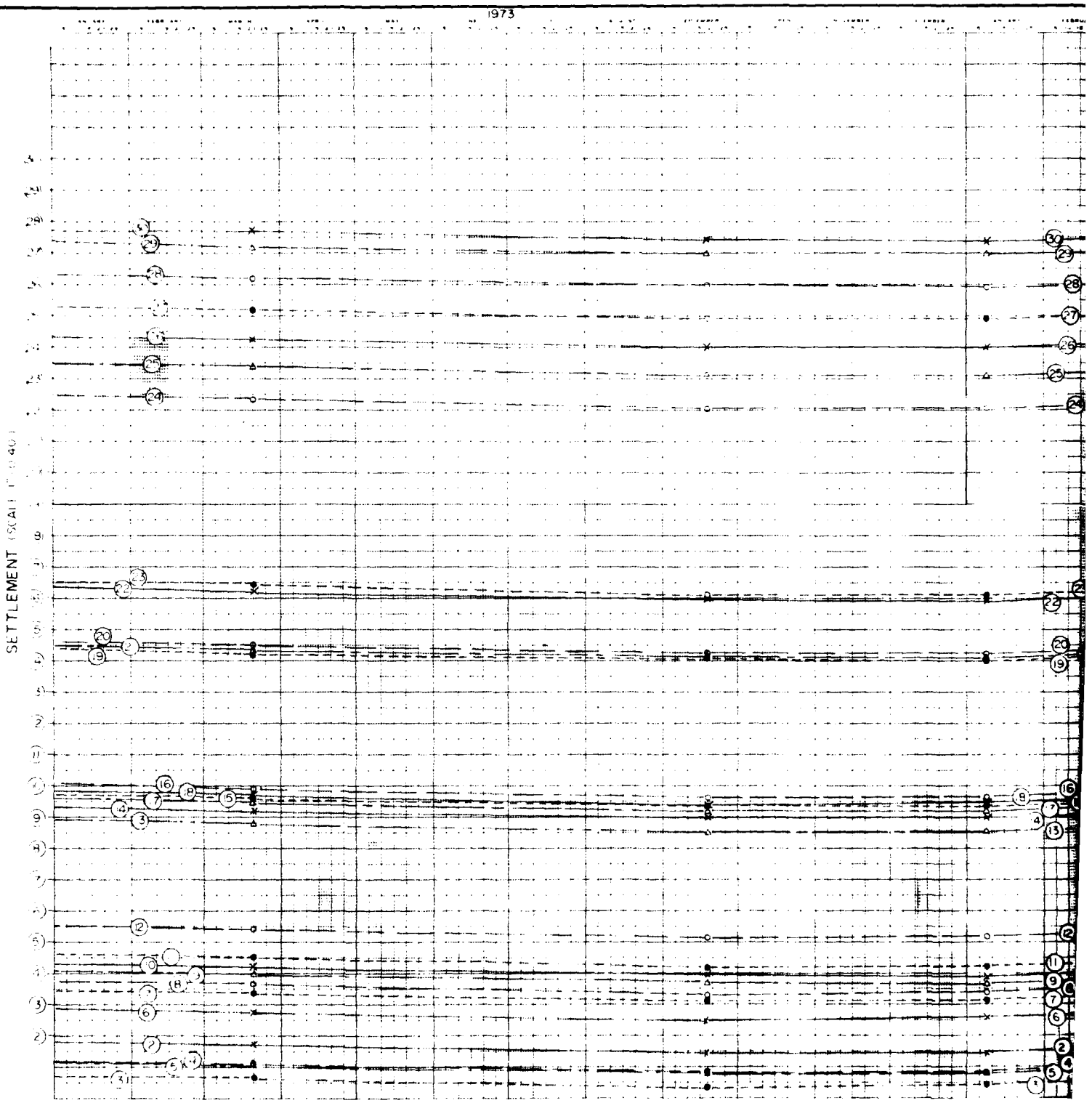
U S ARMY



LEHIGH RIVER BASIN
POHOPOCO CREEK, PA.
BELTZVILLE LAKE
SUBSURFACE SETTLEMENT DATA
VIF - 92 - 2 1971 - 1972

PLATE 10

CORPS OF ENGINEERS



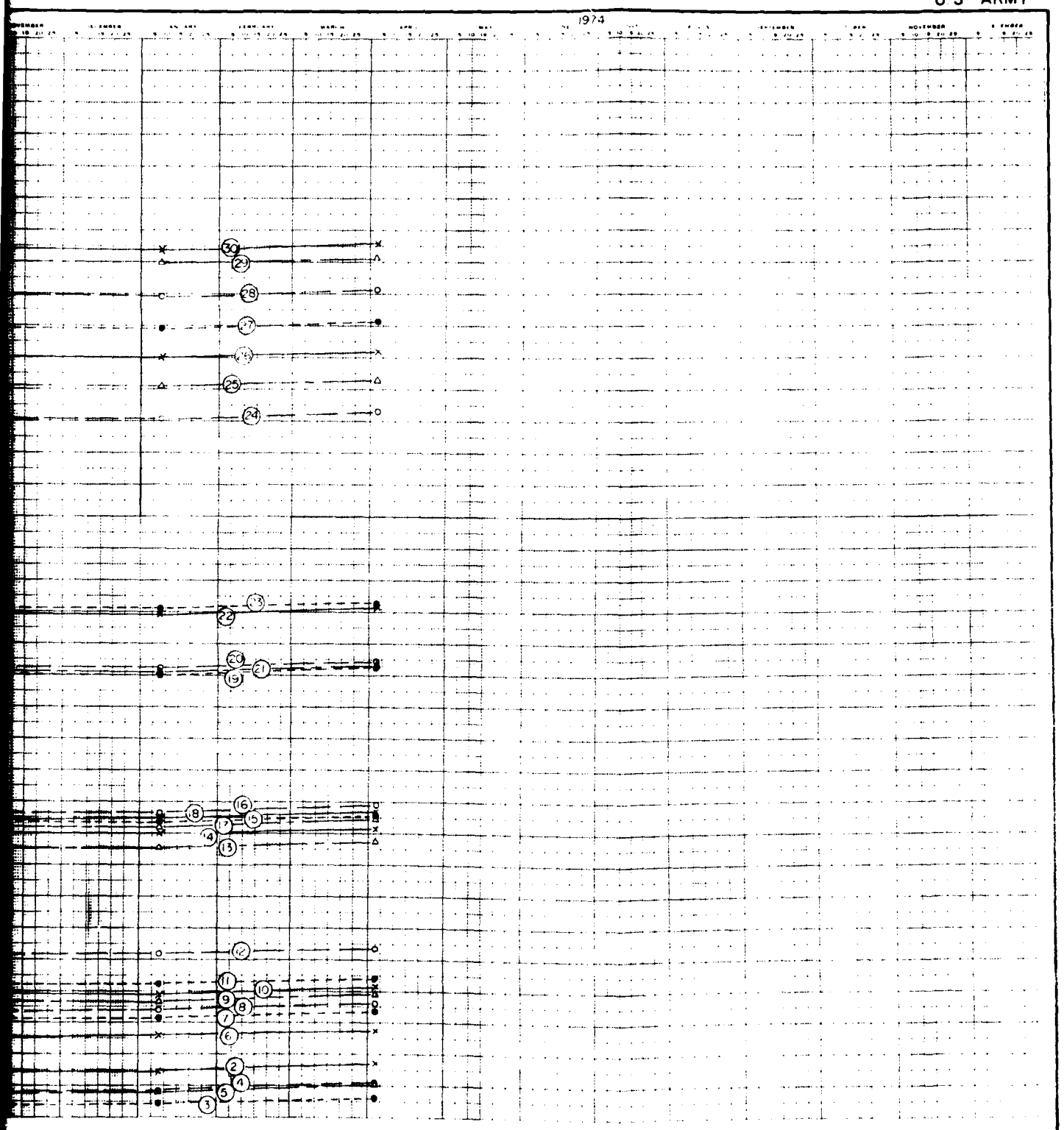

NOTE

- Initial datum for settlement of section casing (2)

(2) [illegible]

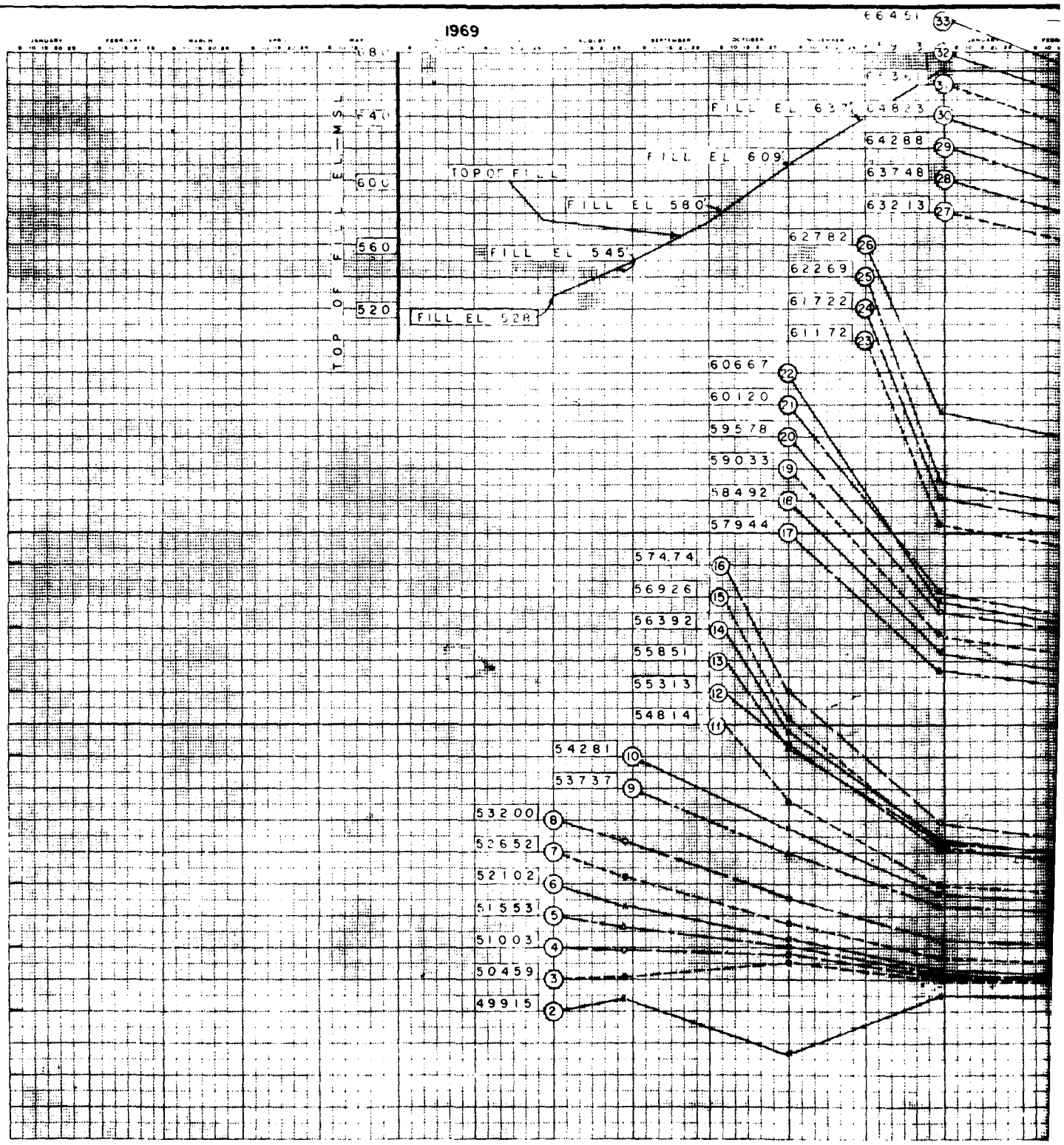
- Measured settlement in section casing (2)

U S ARMY



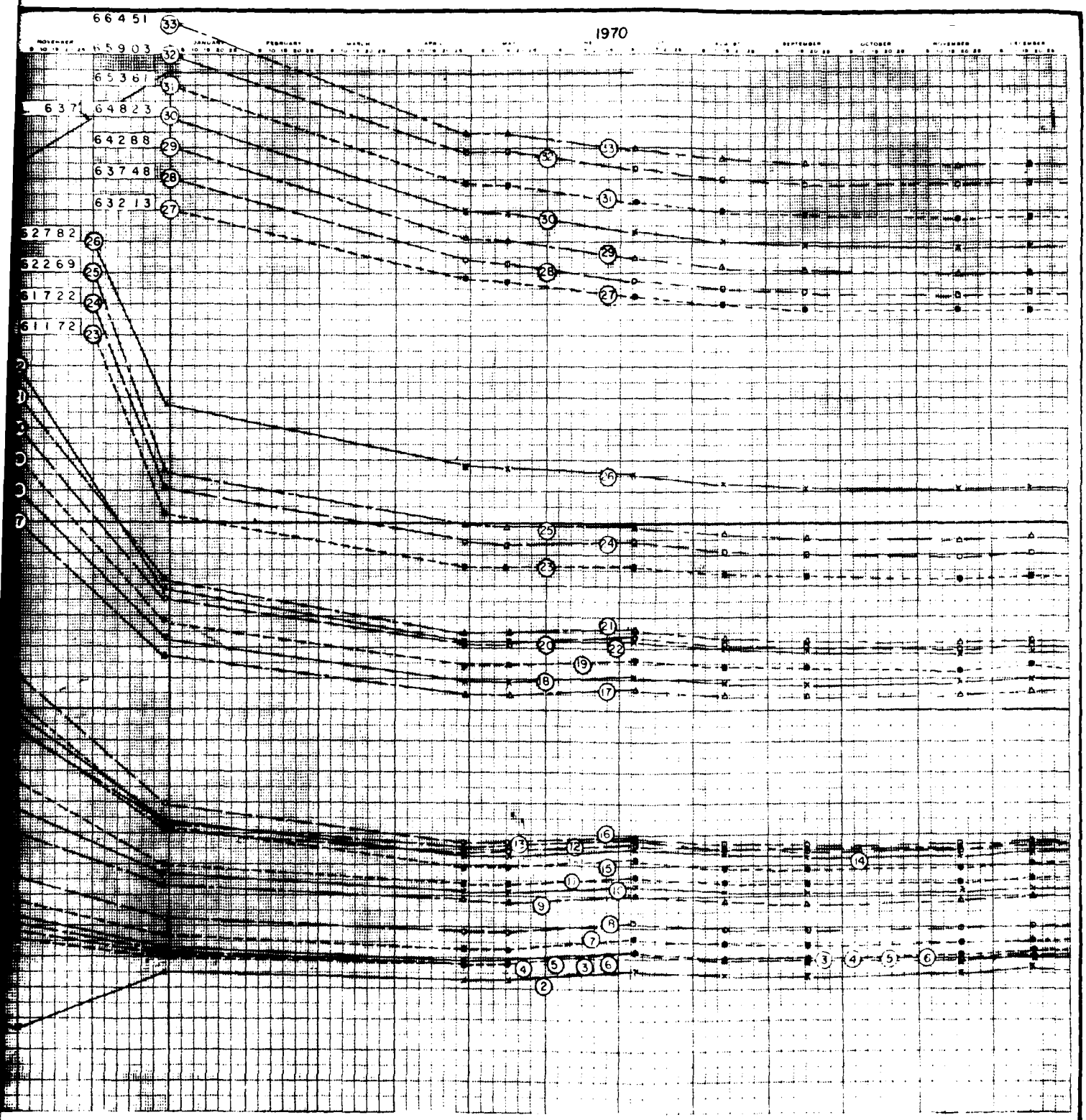

LEHIGH RIVER BASIN
POHOPOCO CREEK, PA.
BELTZVILLE LAKE
SUBSURFACE SETTLEMENT DATA
VIF - 92 - 2 1973-1974

PLATE 11




SETTLEMENT
SCALE 1" = 0.40'

NOTE

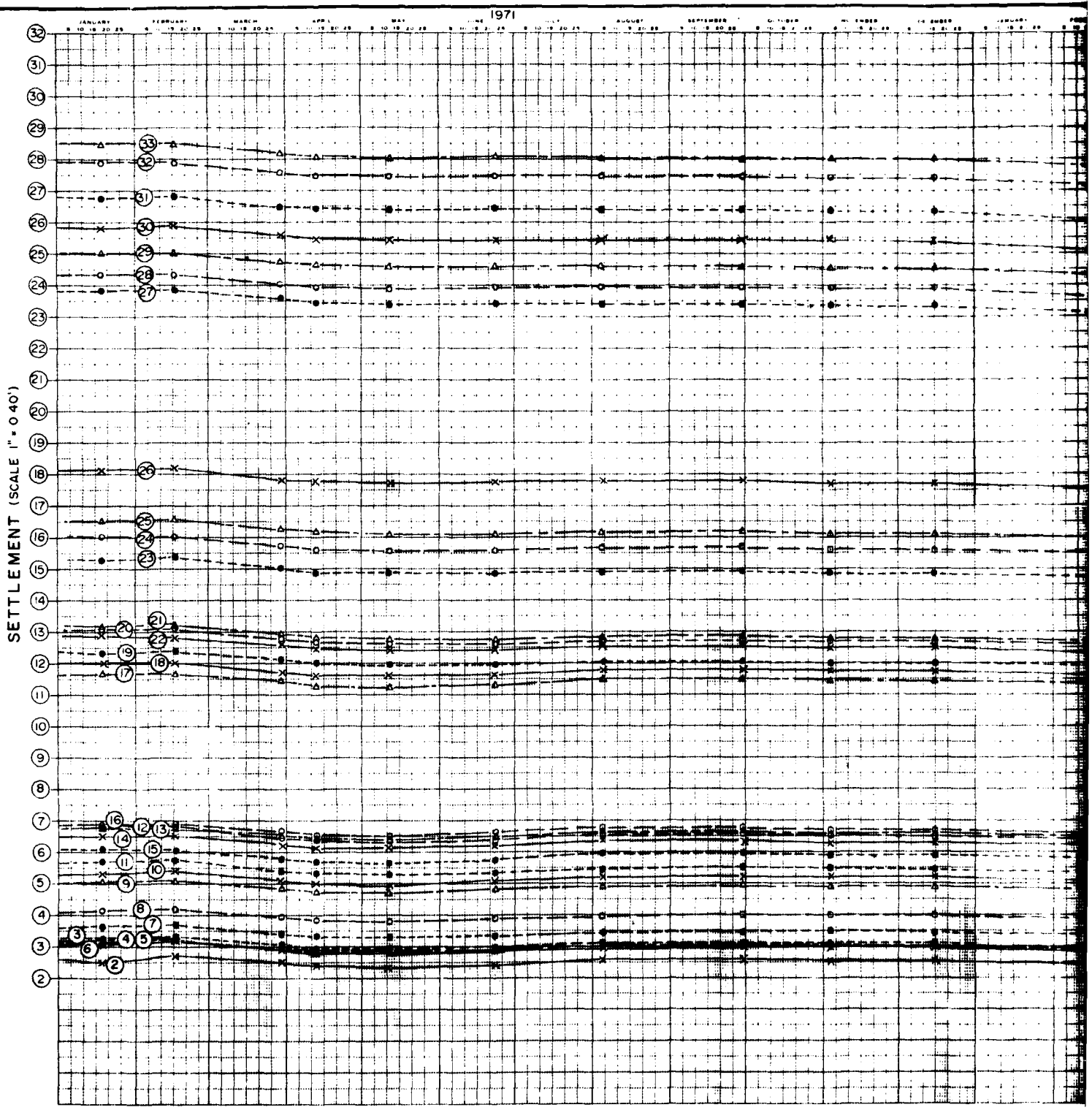



NOTE 49915 (2) - INITIALLY INSTALLED BOTTOM ELEVATION FOR CASING #2

LEHIGH RIVER BASIN
POHOPOCO CREEK, PA.
BELTZVILLE LAKE
SUBSURFACE SETTLEMENT DATA
VIF - 95 - 2 1969 - 1970

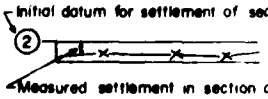
PLATE 12

CORPS OF ENGINEERS

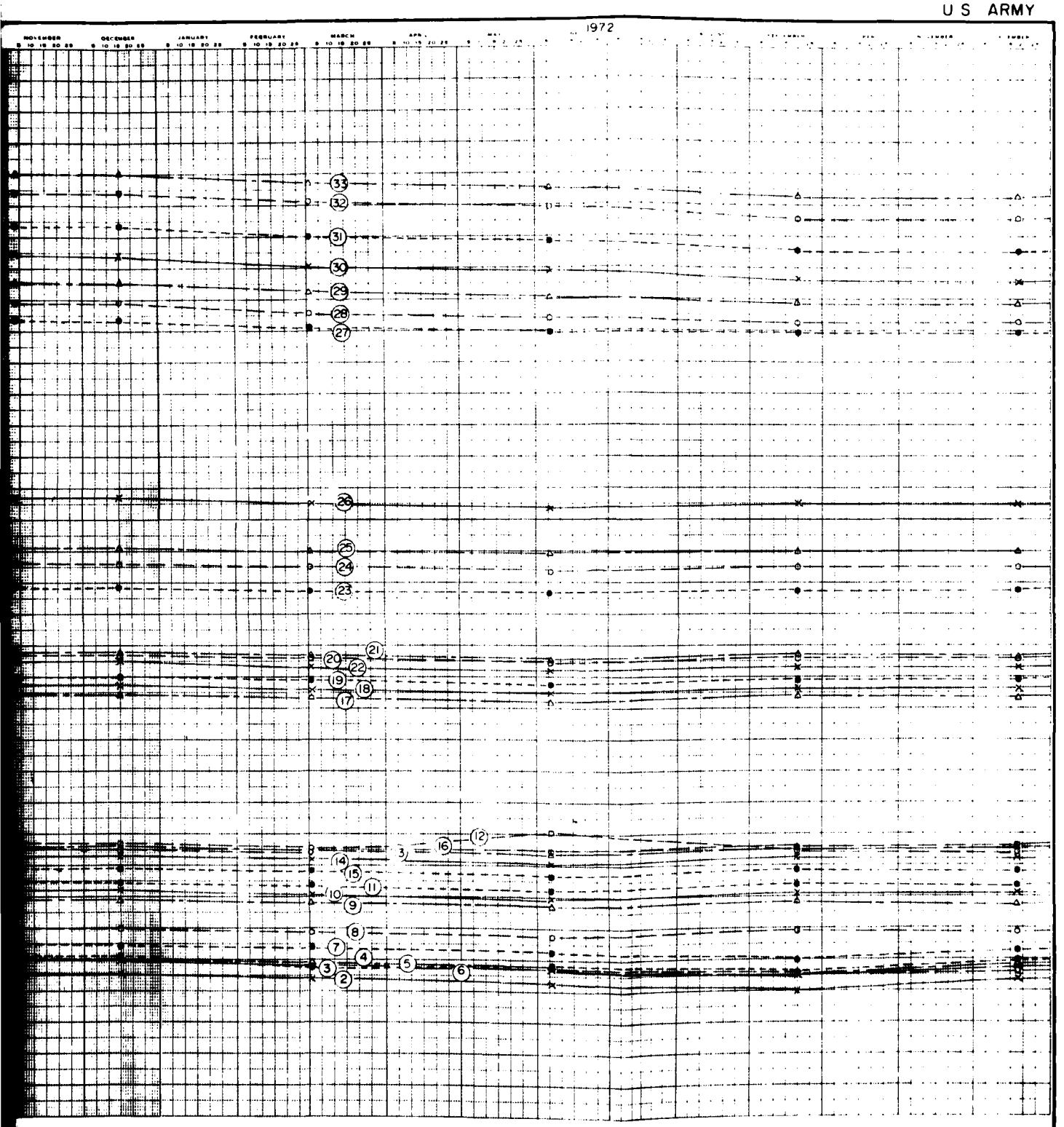



NOTE:

Initial datum for settlement of section casing (2)



Measured settlement in section casing (2)

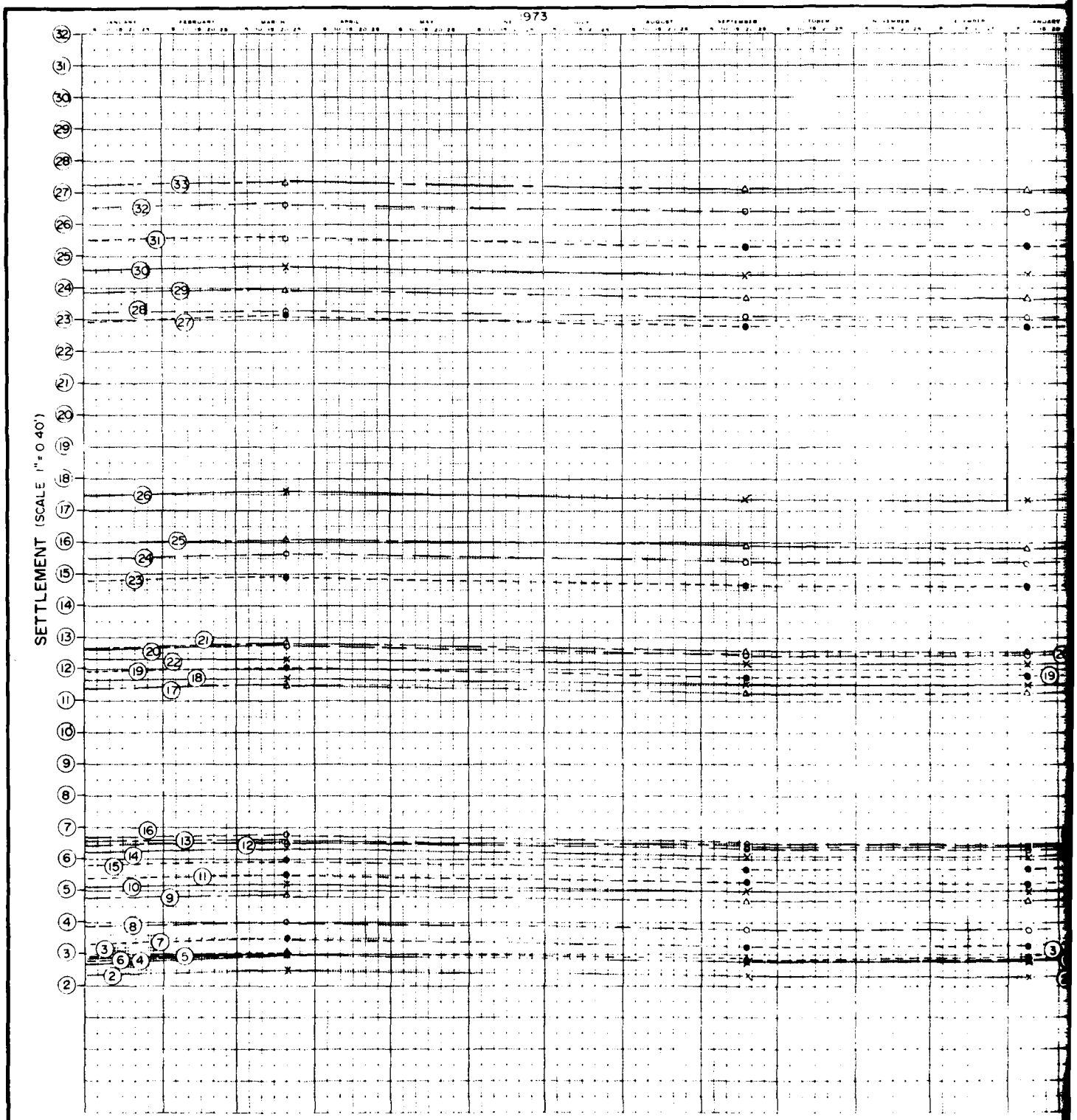



LEHIGH RIVER BASIN
POHOPOCO CREEK, PA.
BELTZVILLE LAKE
SUBSURFACE SETTLEMENT DATA
VIF - 95 - 2 1971 - 1972



12

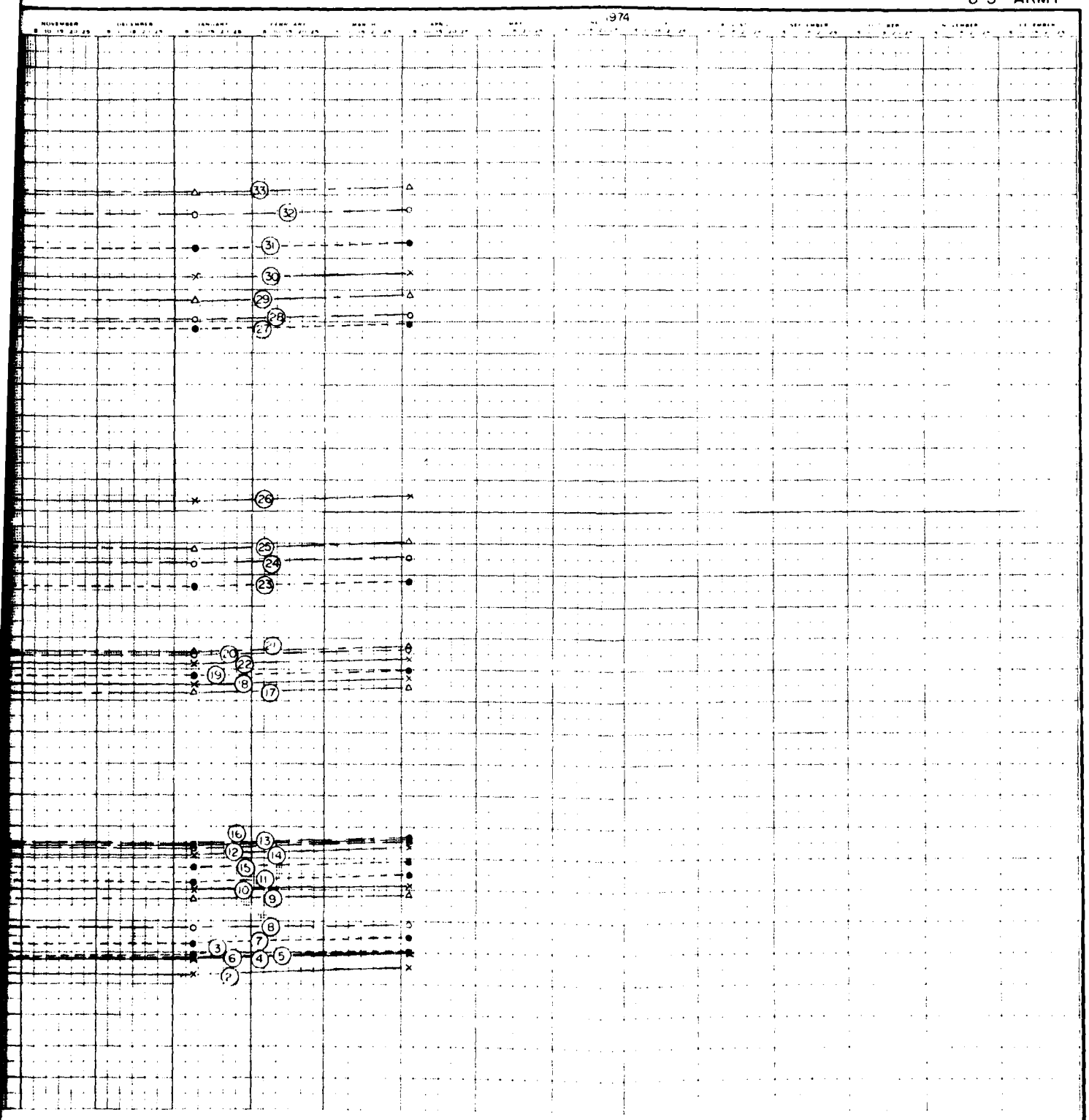
CORPS OF ENGINEERS



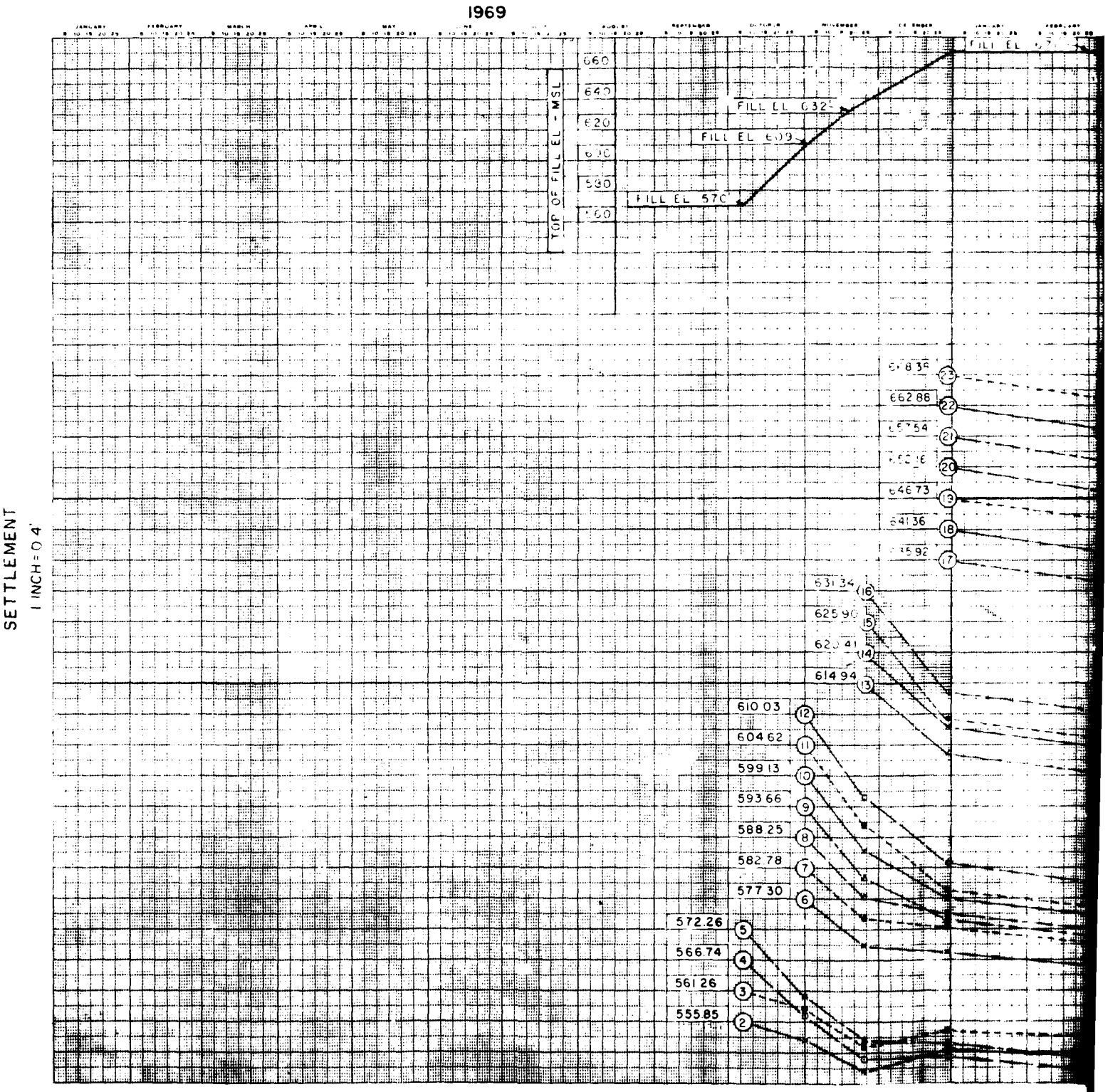

NOTE

Initial datum for settlement of section casing (2)

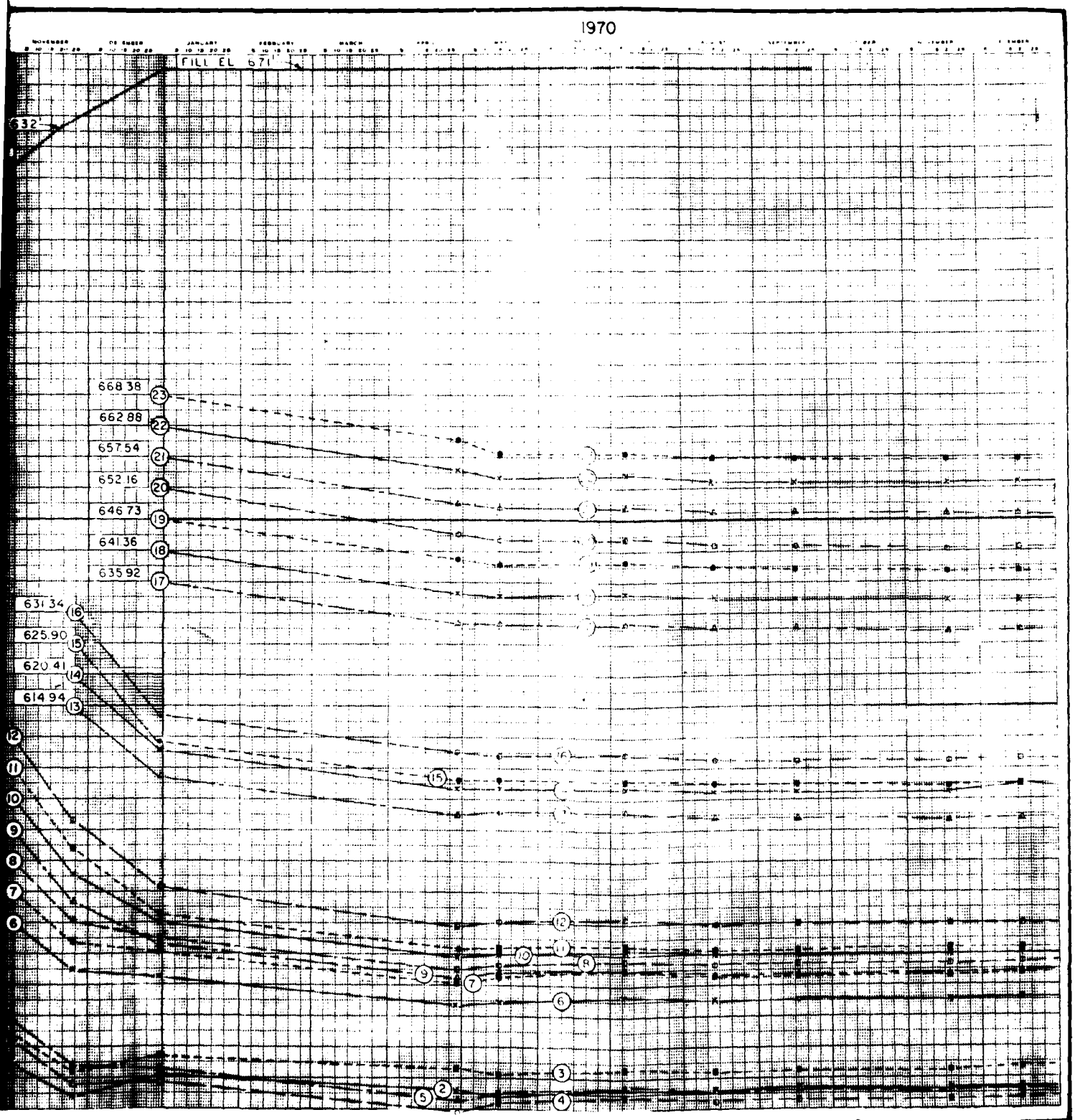
Measured settlement in section casing (2)




LEHIGH RIVER BASIN
POHOPOCO CREEK, PA
BELTZVILLE LAKE
SUBSURFACE SETTLEMENT DATA
VIF - 95 - 2 1973 - 1974


1969
JANUARY
FEBRUARY
MARCH
APRIL
MAY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
JANUARY
FEBRUARY
TOP OF FILL EL - MSL
660
640
620
600
580
560
FILL EL 632
FILL EL 609
FILL EL 570
662.88
646.73
641.36
631.34
625.90
614.94
610.03
604.62
599.13
593.66
588.25
582.78
577.30
572.26
566.74
561.26
555.85
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
SETTLEMENT
1 INCH = 0.4'

NOTE
555.85 ②



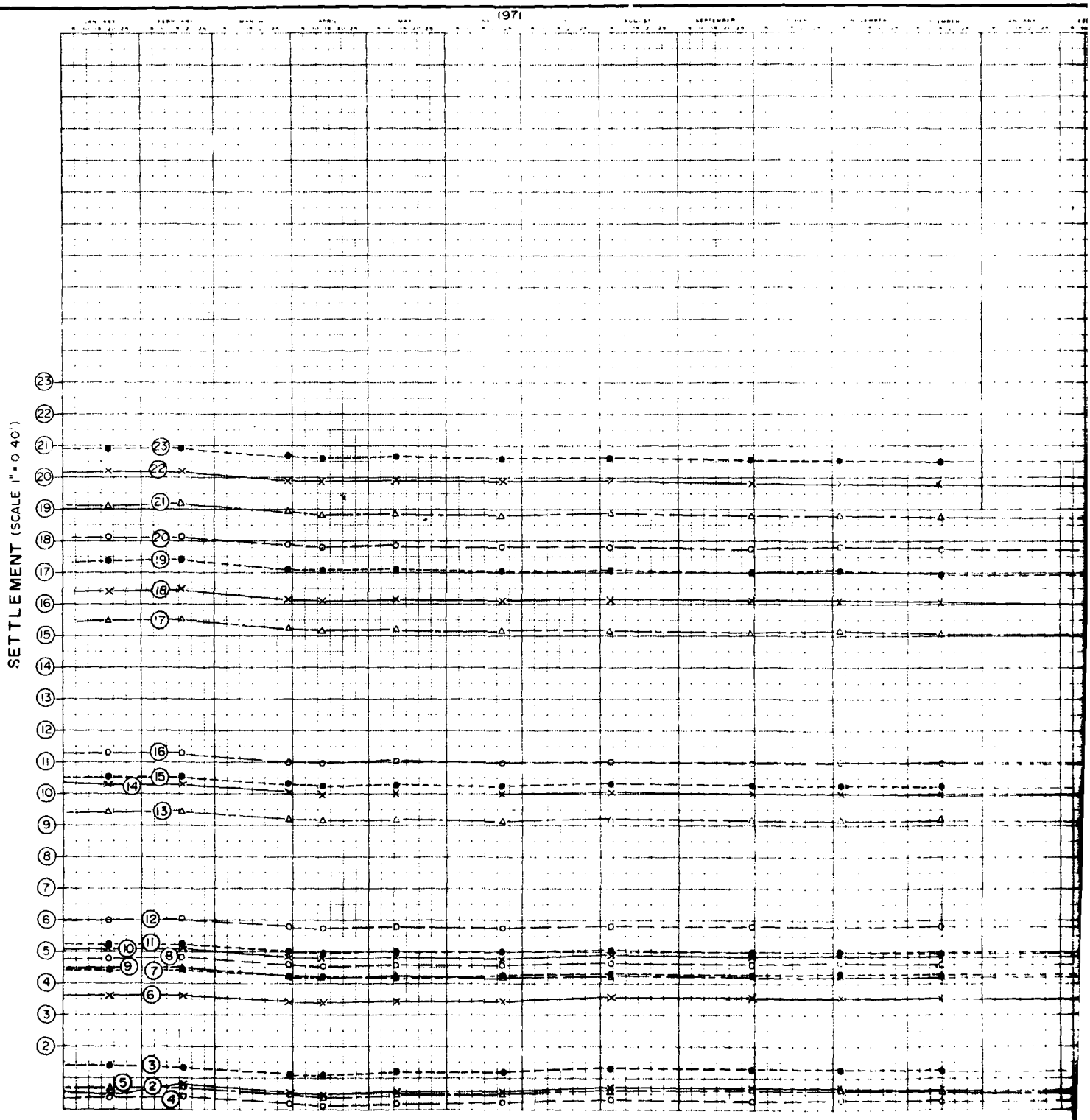

NOTE

555.85 ② = INITIALLY INSTALLED BOTTOM ELEVATION FOR CASING #2

**LEHIGH RIVER BASIN**
**POHOPOCO CREEK, PA**
BELTZVILLE LAKE
**SUBSURFACE SETTLEMENT DATA**
VIF-98-5 1969-1970

PLATE 15

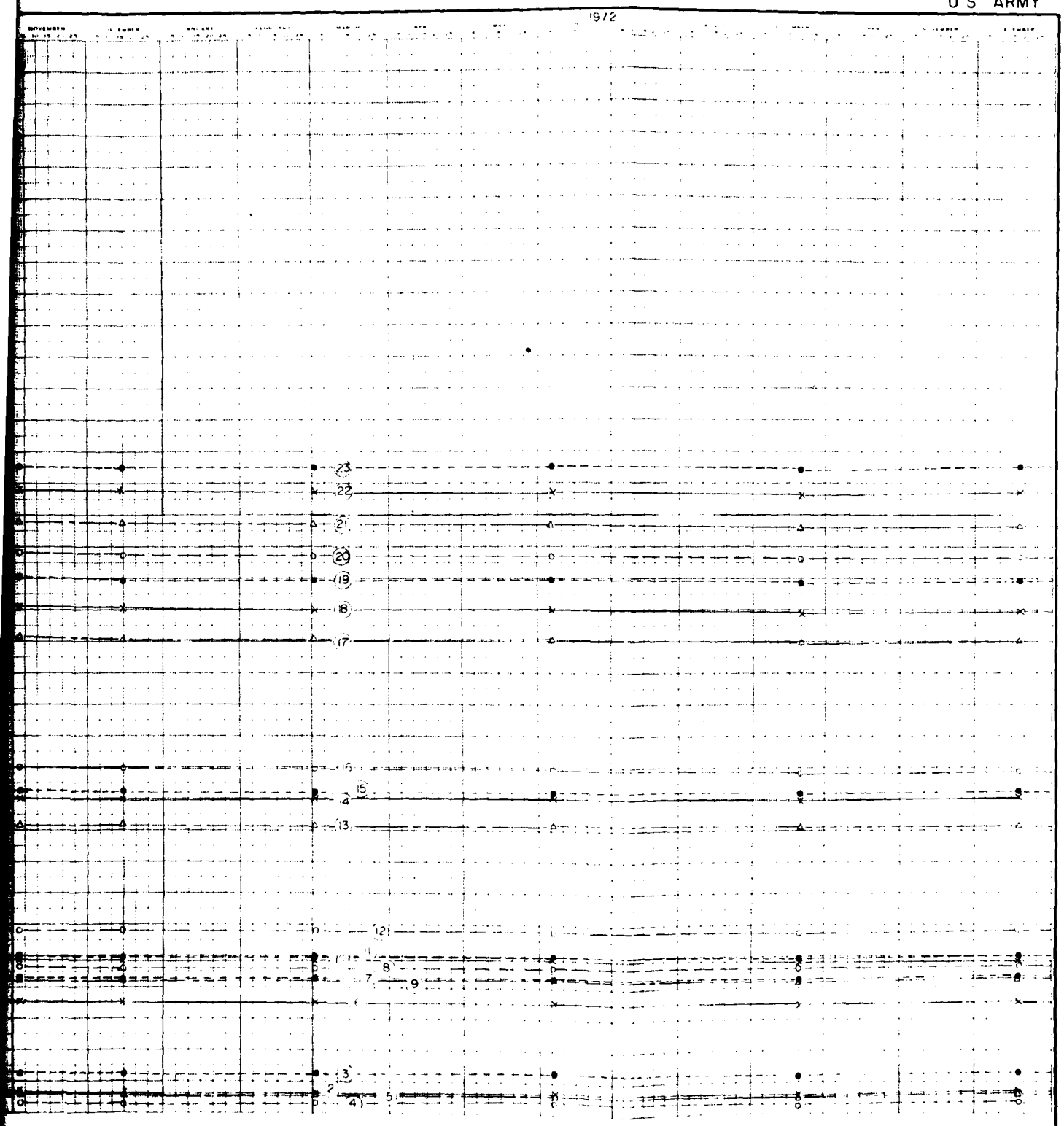
CORPS OF ENGINEERS




NOTE:

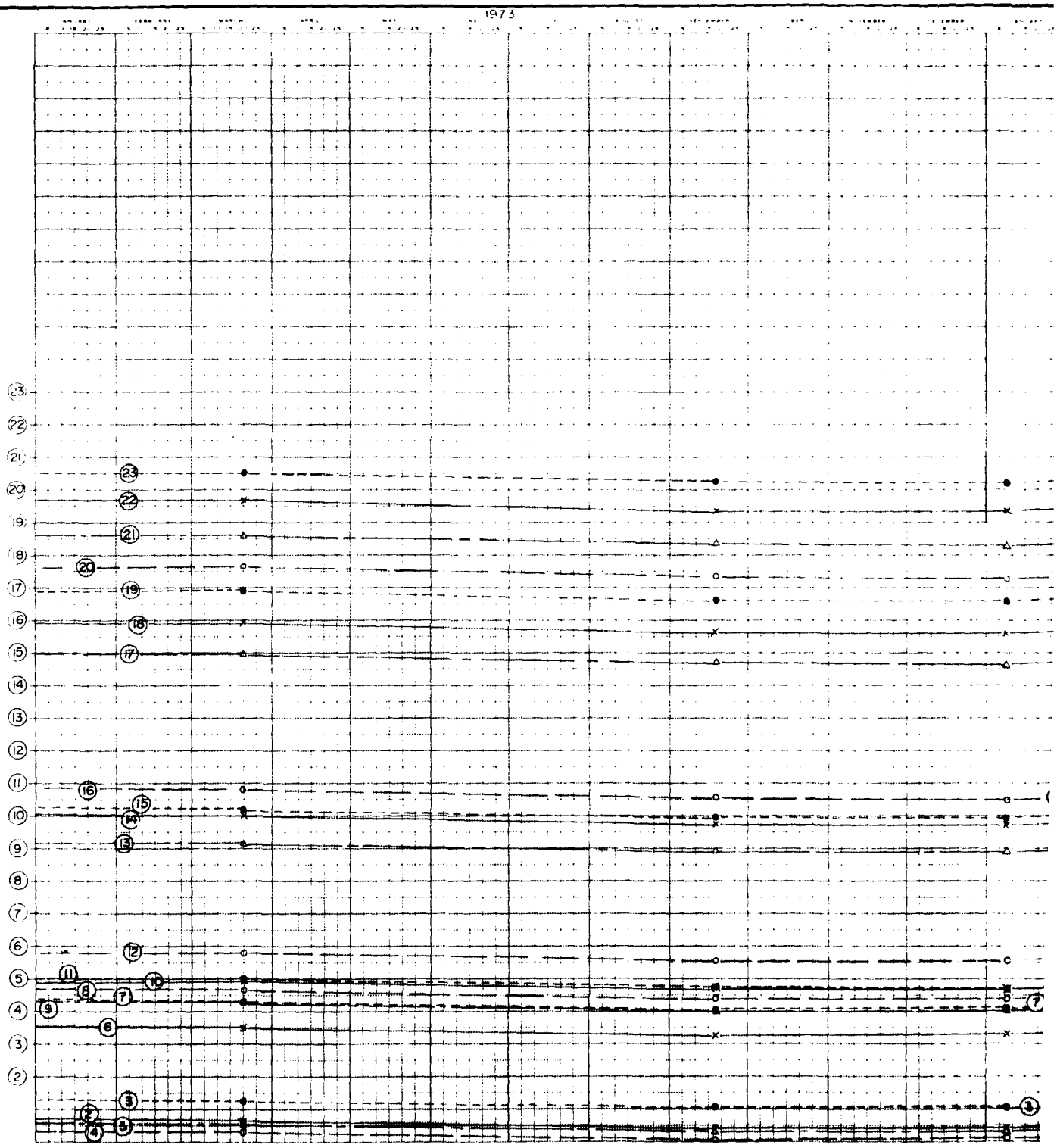
Initial datum for settlement of section casing (2)

Measured settlement in section casing (2)




LEHIGH RIVER BASIN
POHOPOCO CREEK, PA.
BELTZVILLE LAKE
SUBSURFACE SETTLEMENT DATA
VIF-98-5 1971-1972

CORPS OF ENGINEERS

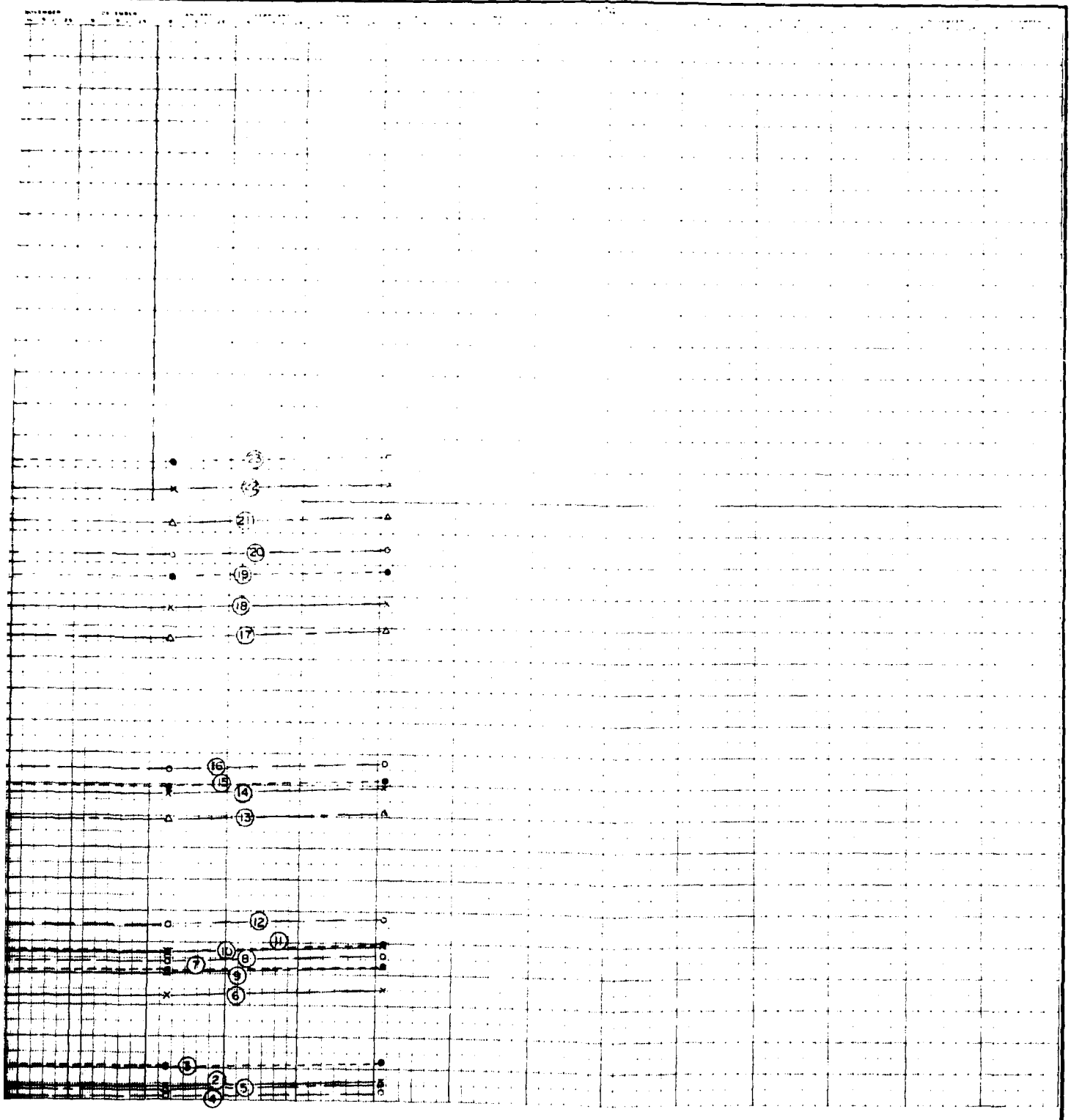



NOTE

Initial datum for settlement of section casing (2)

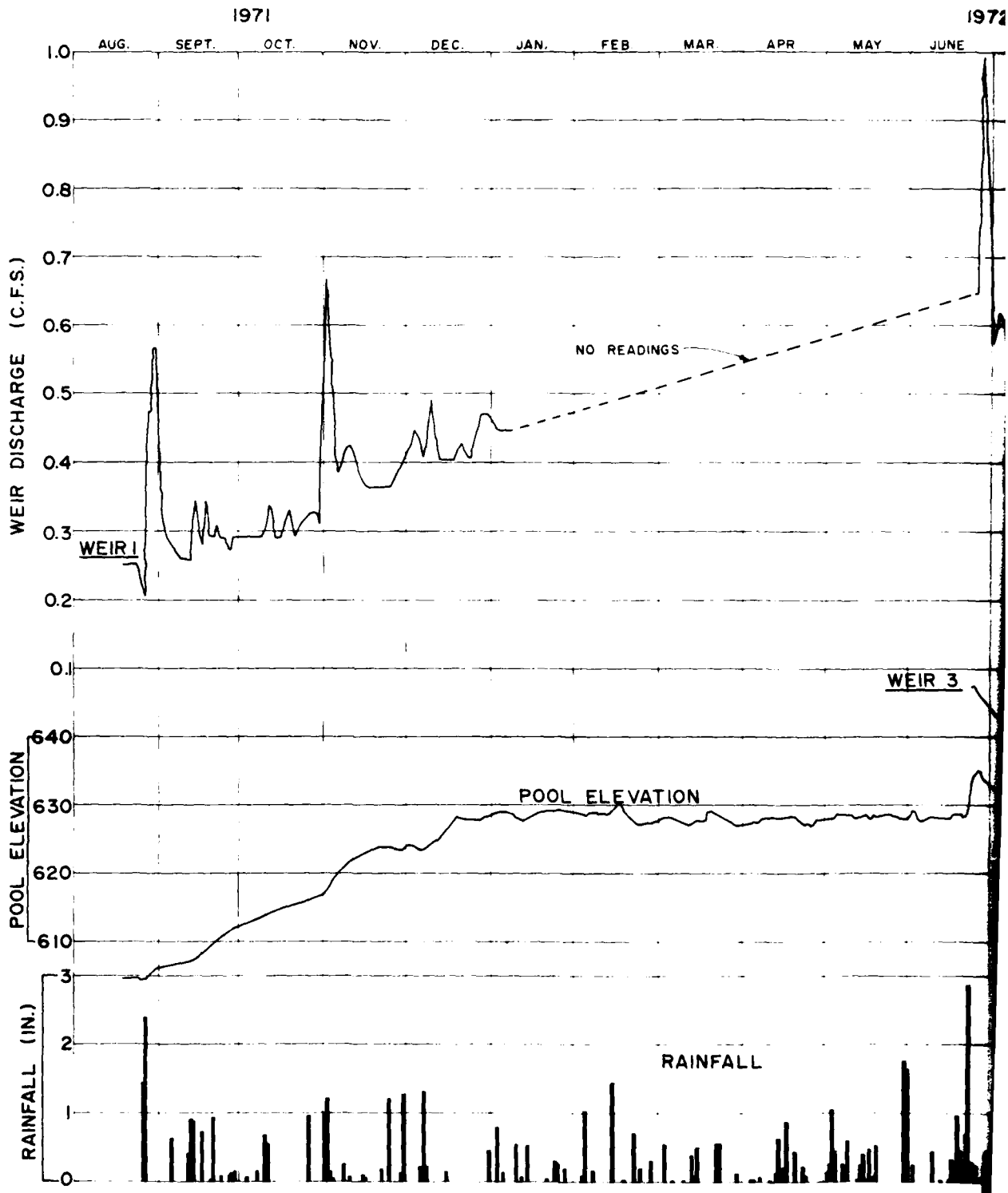
Measured settlement in section casing (2)

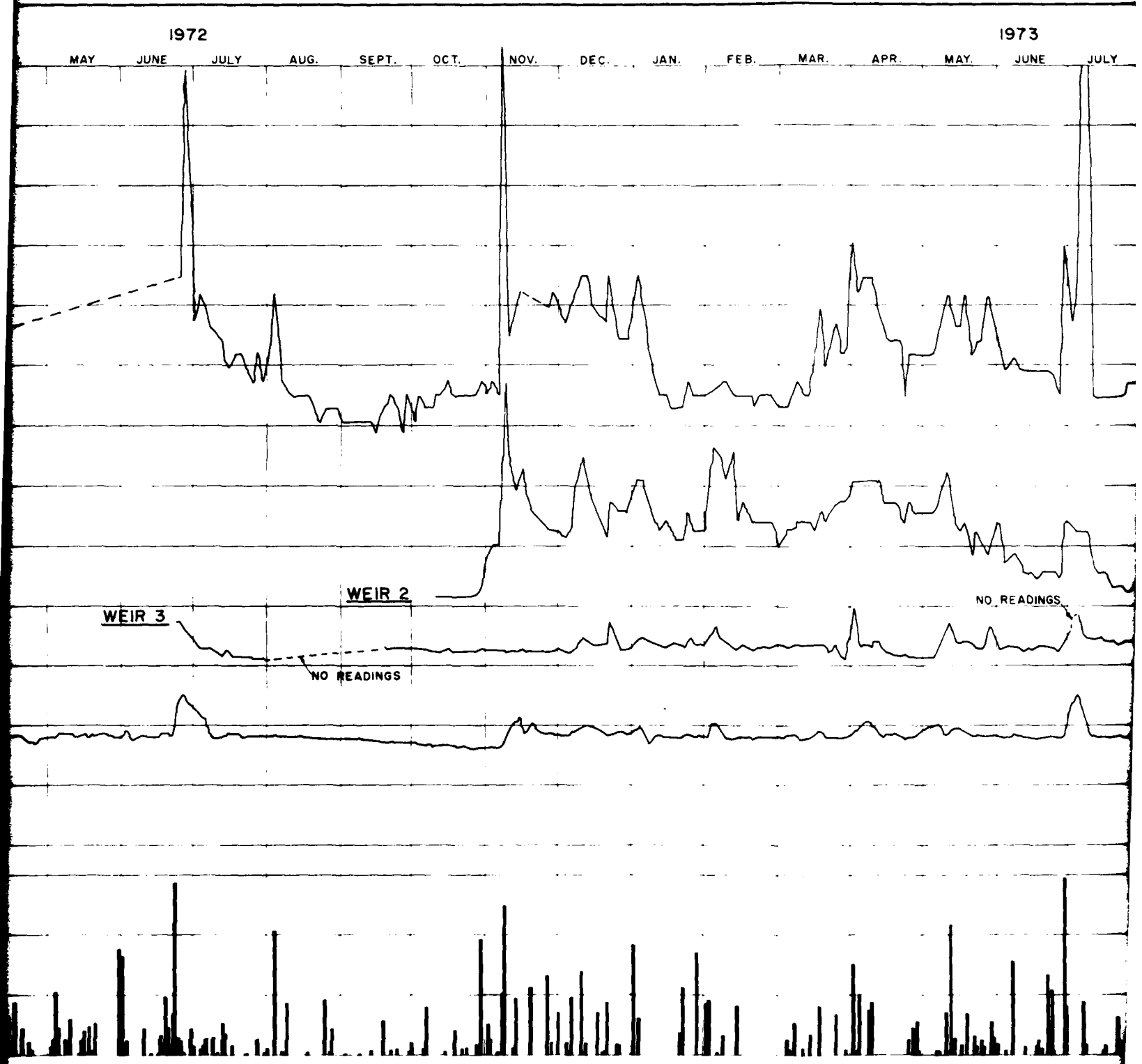
U S ARMY

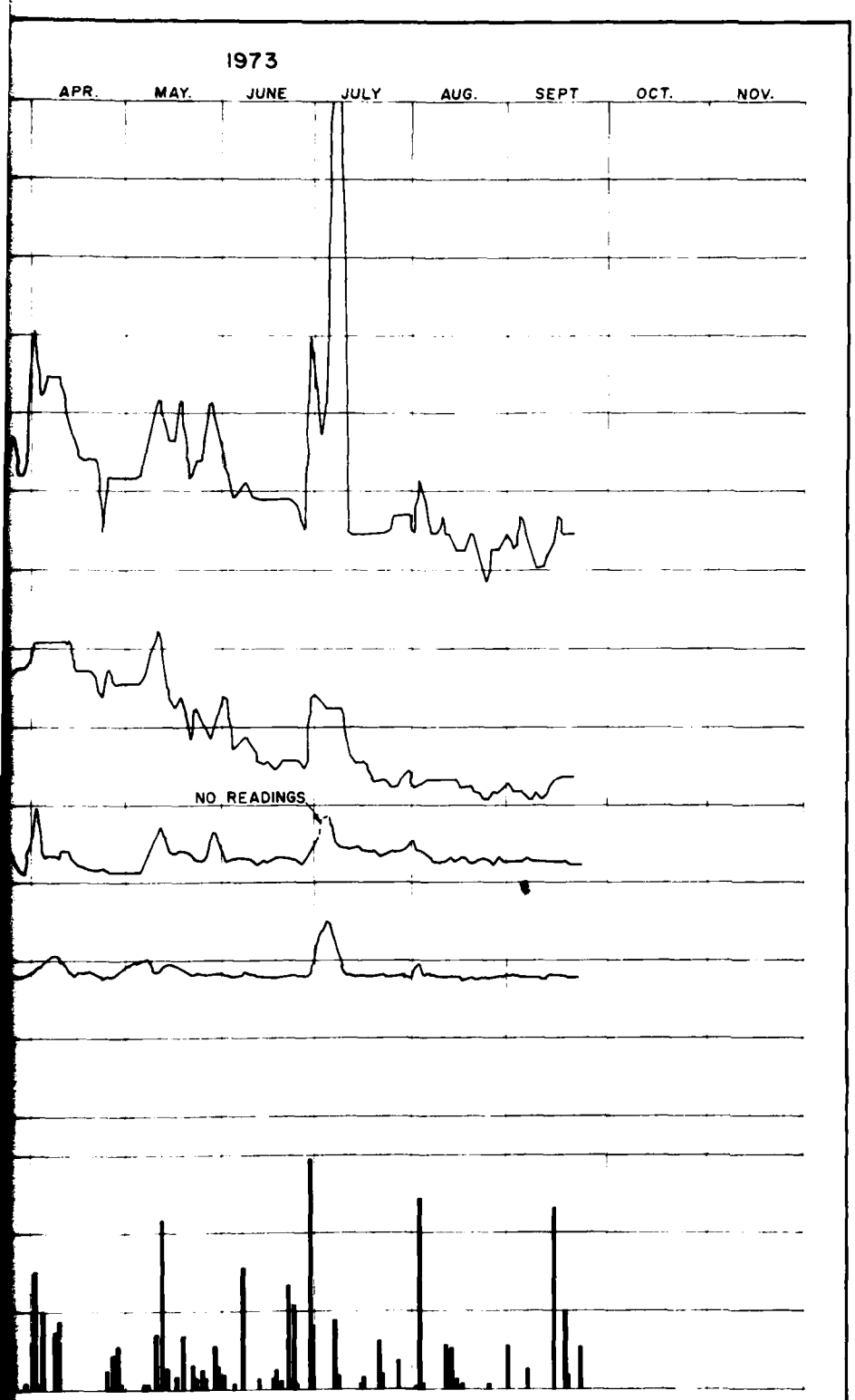



LEHIGH RIVER BASIN
F··IOPOCO CREEK, PA
BELTZVILLE LAKE
SUBSURFACE SETTLEMENT DATA
VIF-98-5 1973-1974

PLATE 17


1971
1972
AUG.
SEPT.
OCT.
NOV.
DEC.
JAN.
FEB.
MAR.
APR
MAY
JUNE
WEIR DISCHARGE (C.F.S.)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
NO READINGS
WEIR 1
WEIR 3
POOL ELEVATION
640
630
620
610
POOL ELEVATION
RAINFALL (IN.)
3
2
1
0
RAINFALL


1972
1973
MAY
JUNE
JULY
AUG.
SEPT.
OCT.
NOV.
DEC.
JAN.
FEB.
MAR.
APR.
MAY.
JUNE
JULY
WEIR 2
WEIR 3
NO READINGS
NO READINGS

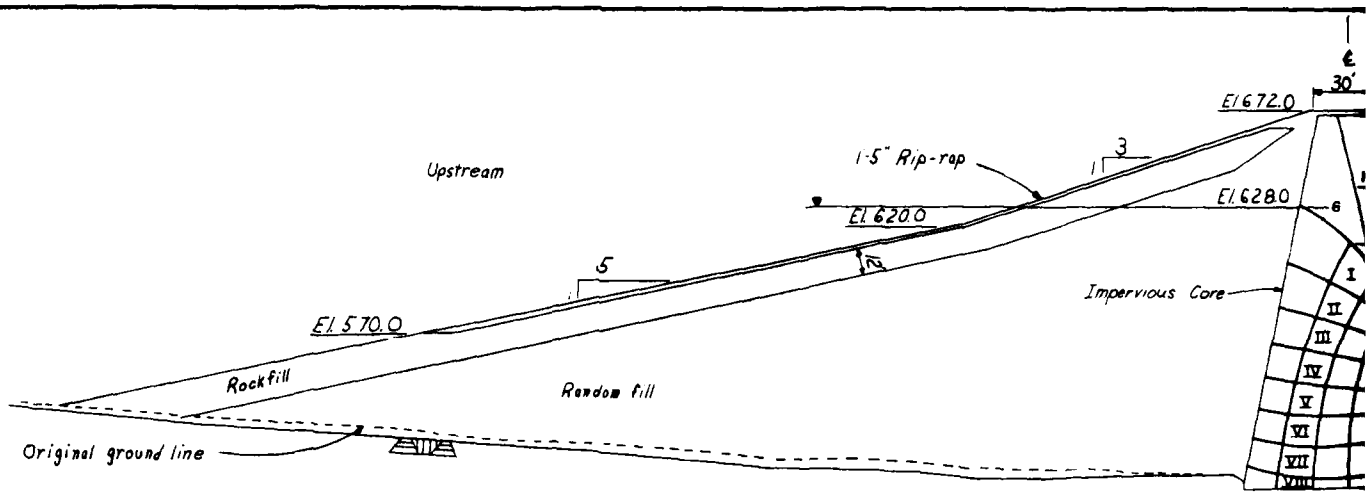



LEHIGH RIVER BASIN

POHOPOCO CREEK, PENNSYLVANIA

BELTZVILLE DAM & RESERVOIR

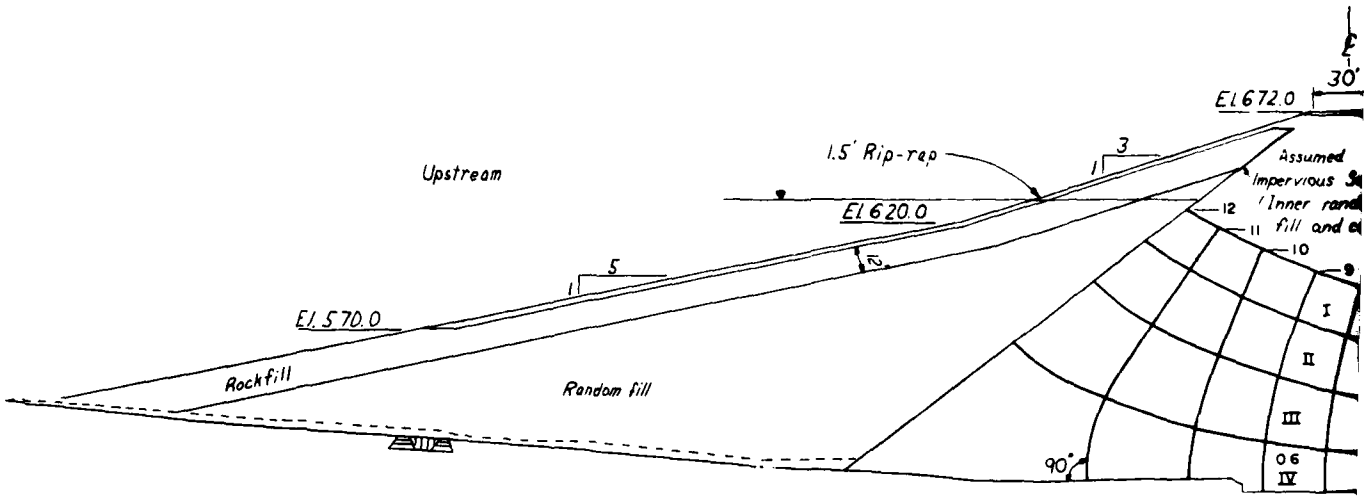
WEIR DISCHARGE




Flow Net Values

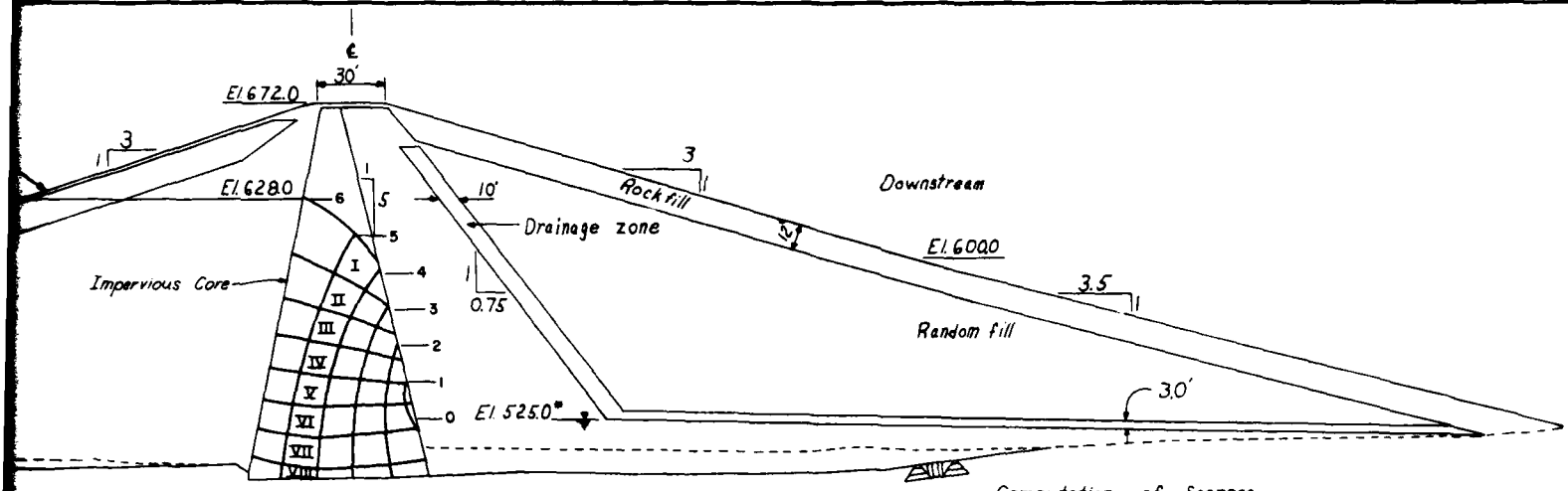
**CASE I.**

* Water level defa
piezometers ppl




Flow Net Values

**CASE 2.**




Flow Net Values $N_f = 7.3$, $N_p = 6.0$

## CASE 1.

* Water level determined from piezometers ppf-95-5 and 95-6

Computation of Seepage

$Q = KH\frac{N_f}{N_p}L$ $K = 0.0002$ fpm

$q = 0.0002 \times 103 \times \frac{7.3}{6.0} \times 1 = 0.02506$ cfm per ft. = 0.1875 gpm per ft

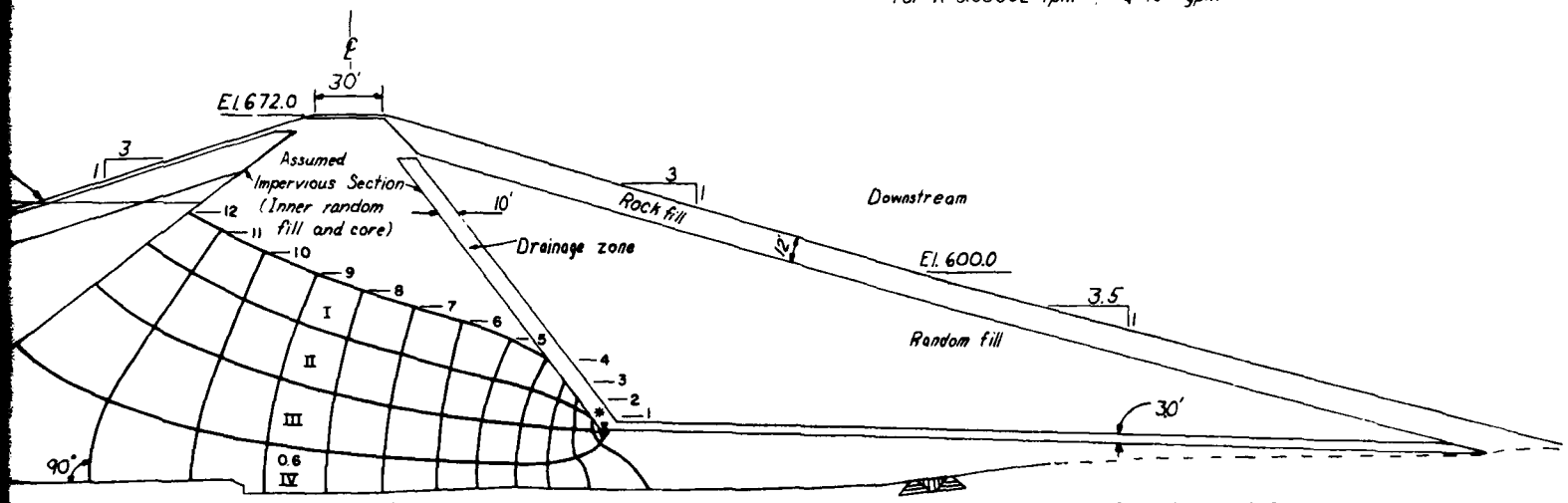
Valley Section $L = 400$ $Q = 0.1875 \times 400 = 75$ gpm

Left Abutment $L = 180$ $Q = 0.1875 \times 180 \times \frac{1}{2} = 17$ gpm

Right Abutment $L = 400$, Avg $H = 82'$ $Q = \frac{82}{103} \times 0.1875 \times 400 = 60$ gpm

Total = 152 gpm

For $K = 0.00002$ fpm, $Q = 15$ gpm




Flow Net Values $N_f = 3.6$, $N_p = 11.6$

## CASE 2.

Computation of Seepage

$Q = KH\frac{N_f}{N_p}L$, $K = 0.0002$ fpm

$q = 0.0002 \times 103 \times \frac{3.6}{11.6} \times 1 = 0.00652$ cfm per ft = 0.04877 gpm per ft

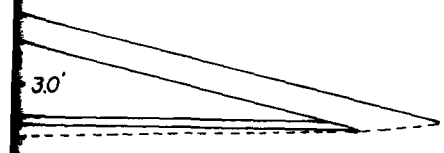
Valley Section $Q = 0.04877 \times 400 = 20$ gpm

Left Abutment $Q = 0.04877 \times 180 \times \frac{1}{2} = 4$ gpm

Right Abutment $Q = \frac{82}{103} \times 0.04877 \times 400 = 16$ gpm

Total = 40 gpm

For $K = 0.00002$ fpm, $Q = 4$ gpm




f Seepage

02 fpm

.02506 cfm per ft. = 0.1875 gpm per ft.

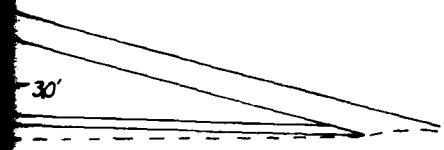
$Q = 0.1875 \times 400 = 75$ gpm

$Q = 0.1875 \times 180 \times \frac{1}{2} = 17$ gpm

$H = 82'$ $Q = \frac{82}{103} \times 0.1875 \times 400 = 60$ gpm

Total = 152 gpm

15 gpm




putation of Seepage

$K = 0.000\ 2$ fpm

$\times \frac{3.6}{11.6} \times 1 = 0.00652$ cfm per ft. = 0.04877 gpm per ft.

$Q = 0.04877 \times 400 = 20$ gpm

$Q = 0.04877 \times 180 \times \frac{1}{2} = 4$ gpm

$Q = \frac{82}{103} \times 0.04877 \times 400 = 16$ gpm

Total = 40 gpm

002 fpm, $Q = 4$ gpm

Scale in feet

40 0 40 80

LEHIGH RIVER BASIN

POHOPOCO CREEK, PENNSYLVANIA

BELTZVILLE LAKE

FLOW NET ANALYSES

STATION 9+580

Appendix A

Condition Report

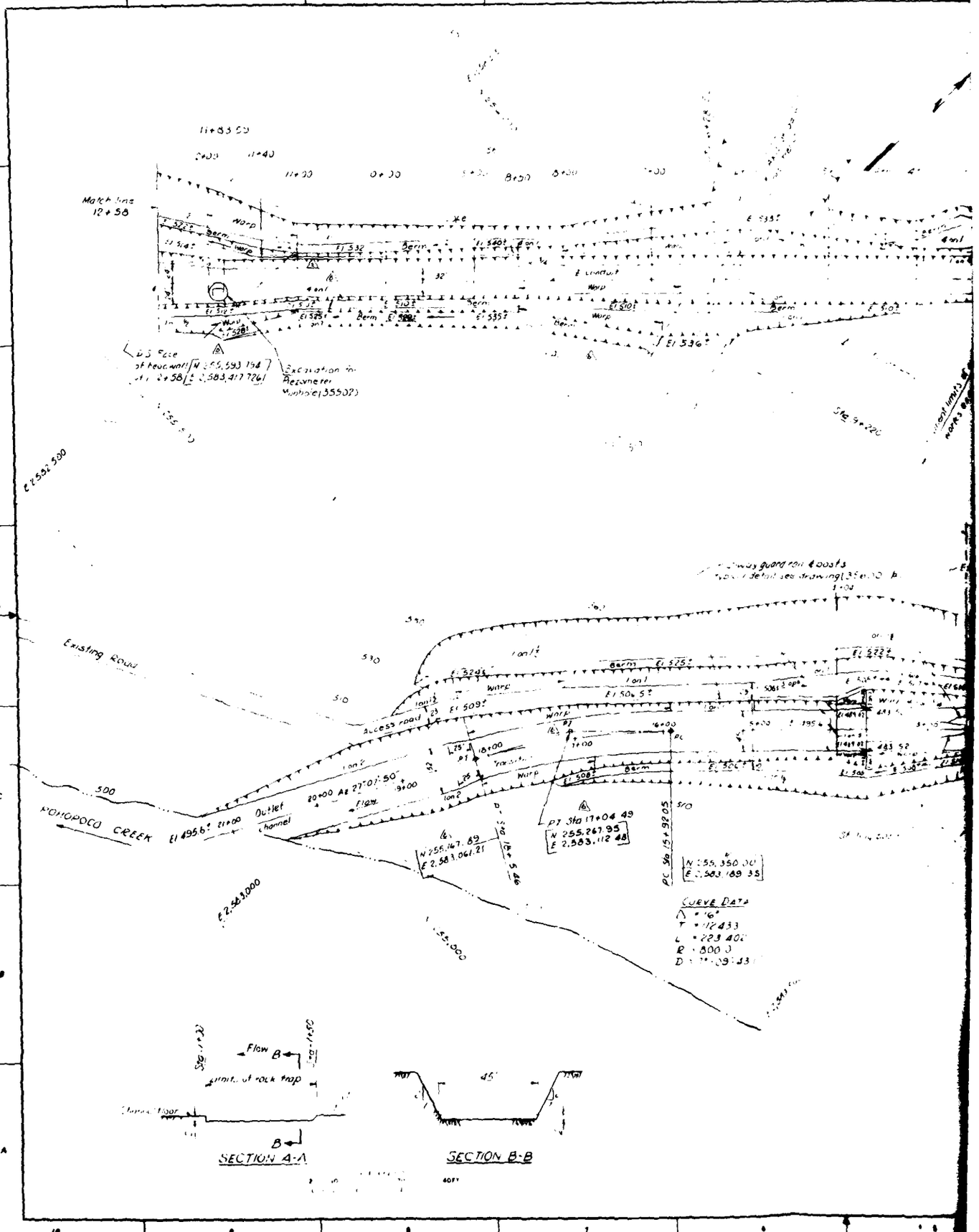
Beltzville Lake

Pohopoco Creek, Pennsylvania

Periodic Inspection Report No. 3 & 4

Supplemental As-Built Drawings

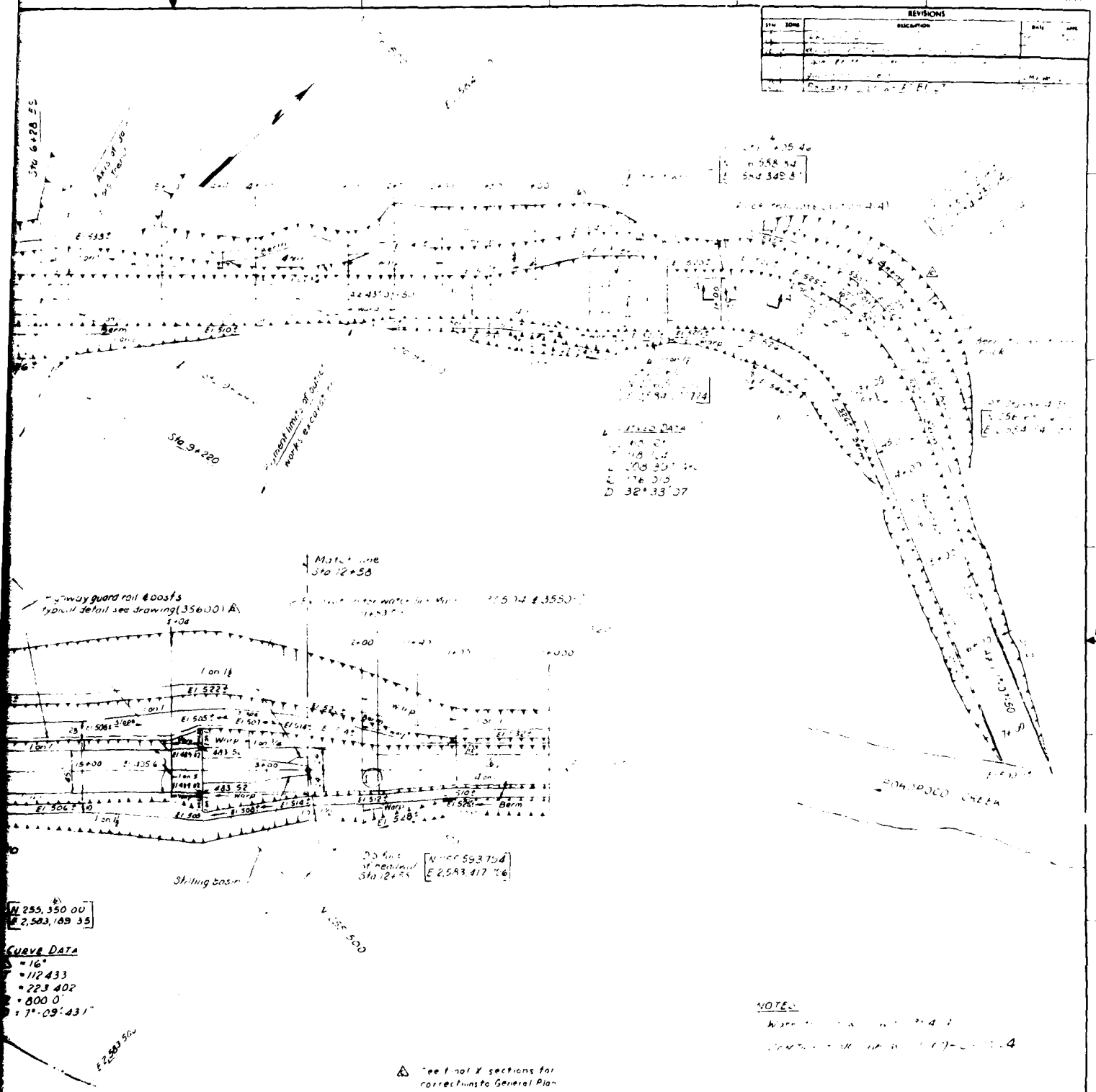
CORPS. OF ENGINEERS



U S ARMY

REVISIONS

| SYM | ZONE | DESCRIPTION | DATE | APPR |
|---|---|---|---|---|
| | | | | |




SCALE 1" = 50'-0"

50 25 0 50' 100 FT

DATE

DRAWN BY | TRACED BY | CHECKED BY J.D.K.

U. S. ARMY ENGINEER DISTRICT, PHILADELPHIA
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
LEHIGH RIVER BASIN
PENNSYLVANIA
BELTZVILLE DAM AND RESERVOIR

# OUTLET WORKS

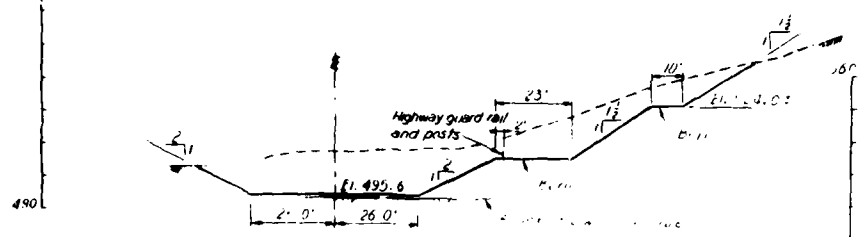
## EXCAVATION - GENERAL PLAN

SIZE F | DWG NO. 35483

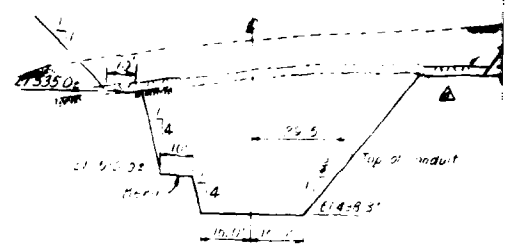
SCALE AS SHOWN

PLATE 20

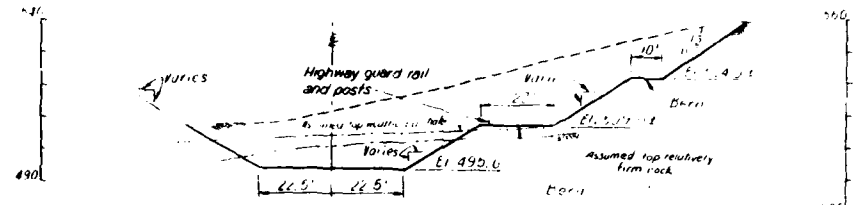
CORPS OF ENGINEERS



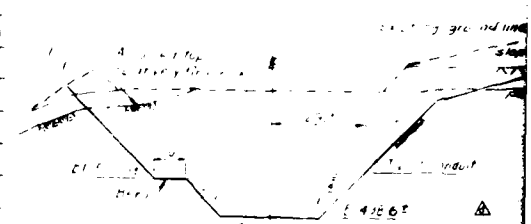

STATION 18+50
(Looking downstream)



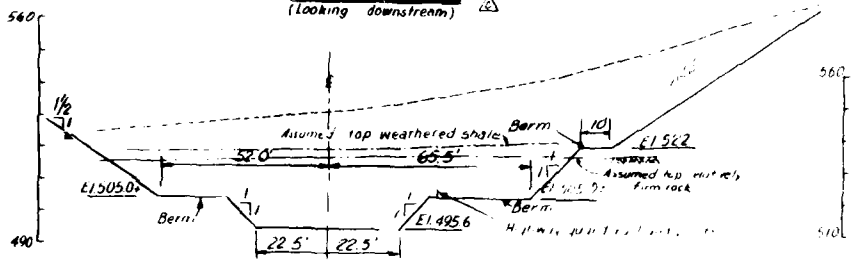

STATION 8+50
(Looking downstream)



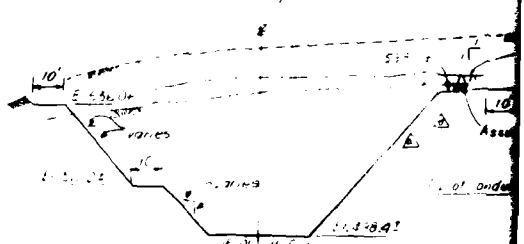

STATION 18+00
(Looking downstream)



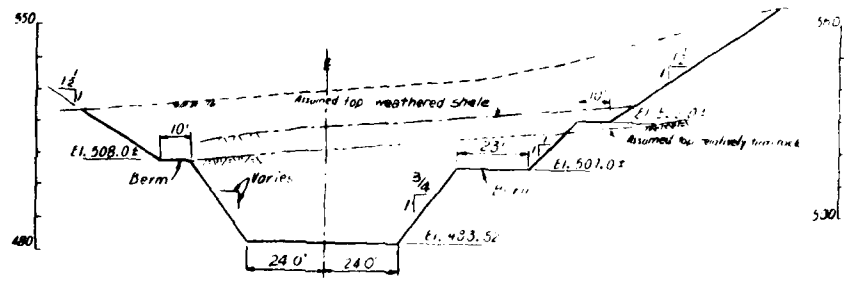
STATION 6+28
(Looking downstream)



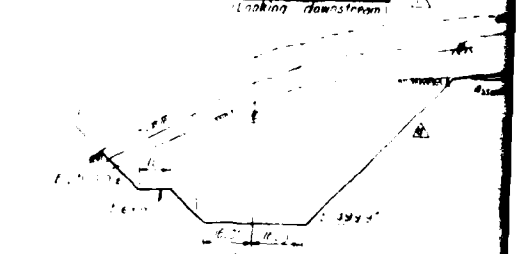

STATION 14+04
(Looking downstream)



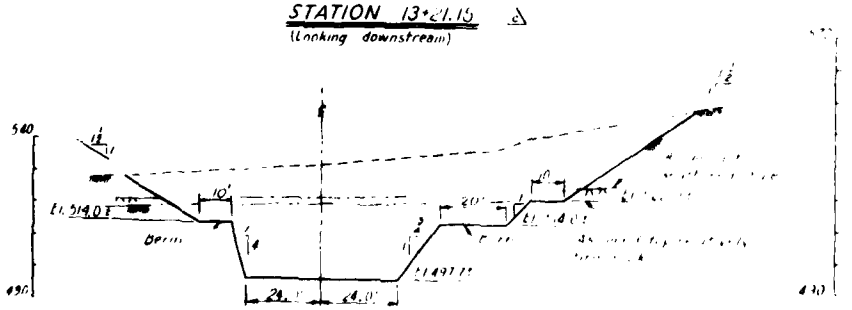

STATION 7+00
(Looking downstream)



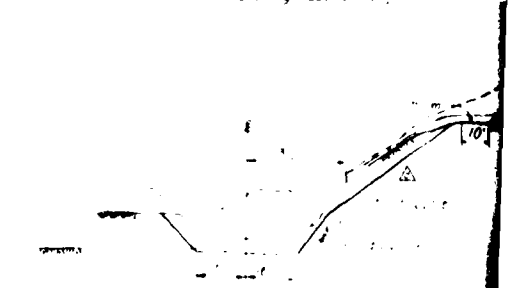

STATION 13+21.15
(Looking downstream)



STATION 5+00
(Looking downstream)




STATION 12+55
(Looking downstream)



STATION [illegible]

NOTES

1. Work this drawing with (35483)
2. * The location and extent of the excavation [illegible] as indicated on the cross sections [illegible] interpreted on available data as the material at site is [illegible] revisions of elevations [illegible] in material may be [illegible]
4. Conduit trench to be backfilled with impervious to 5' above weathered shale [illegible] remainder of trench [illegible]

U.S. ARMY

REVISIONS

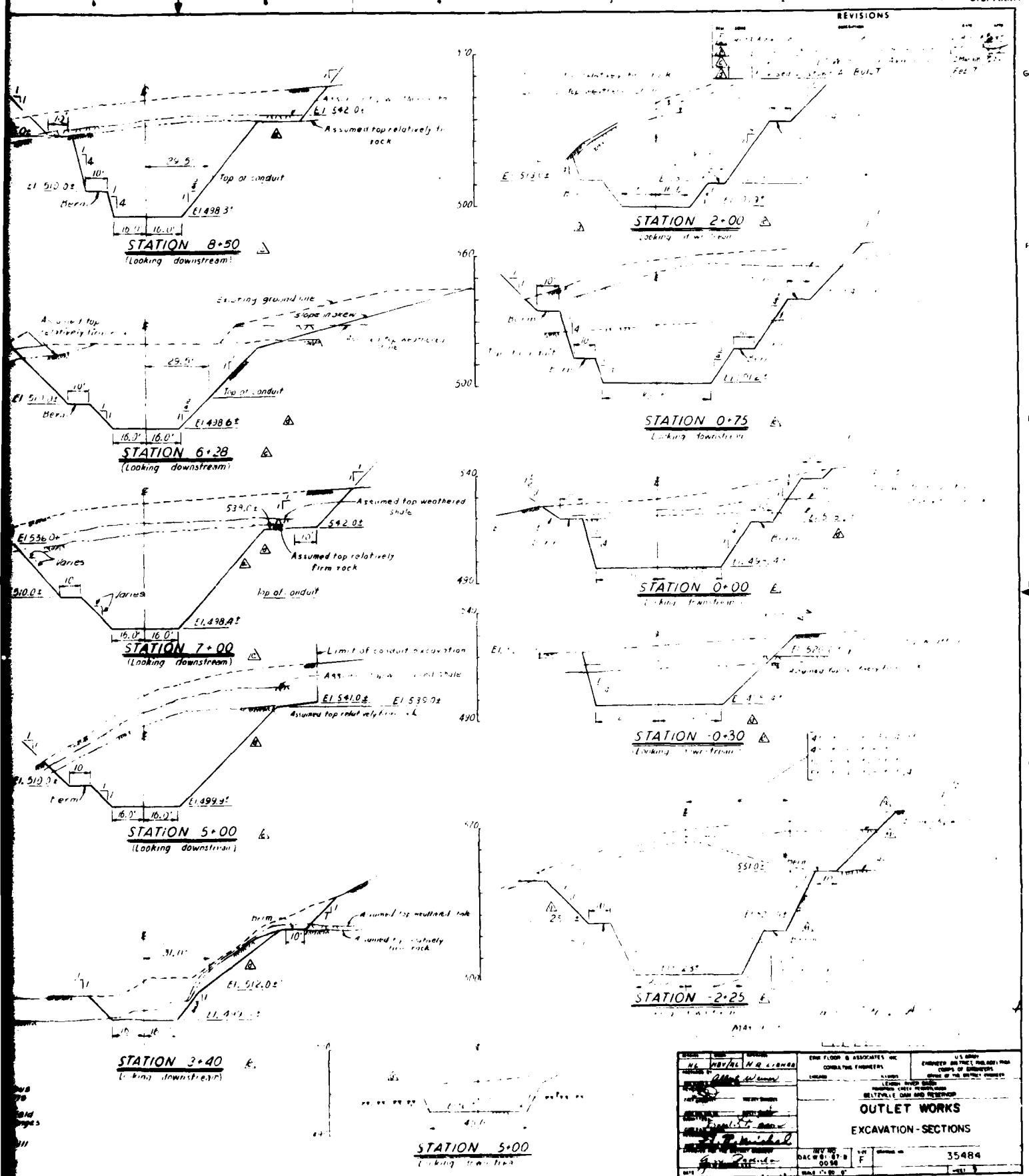
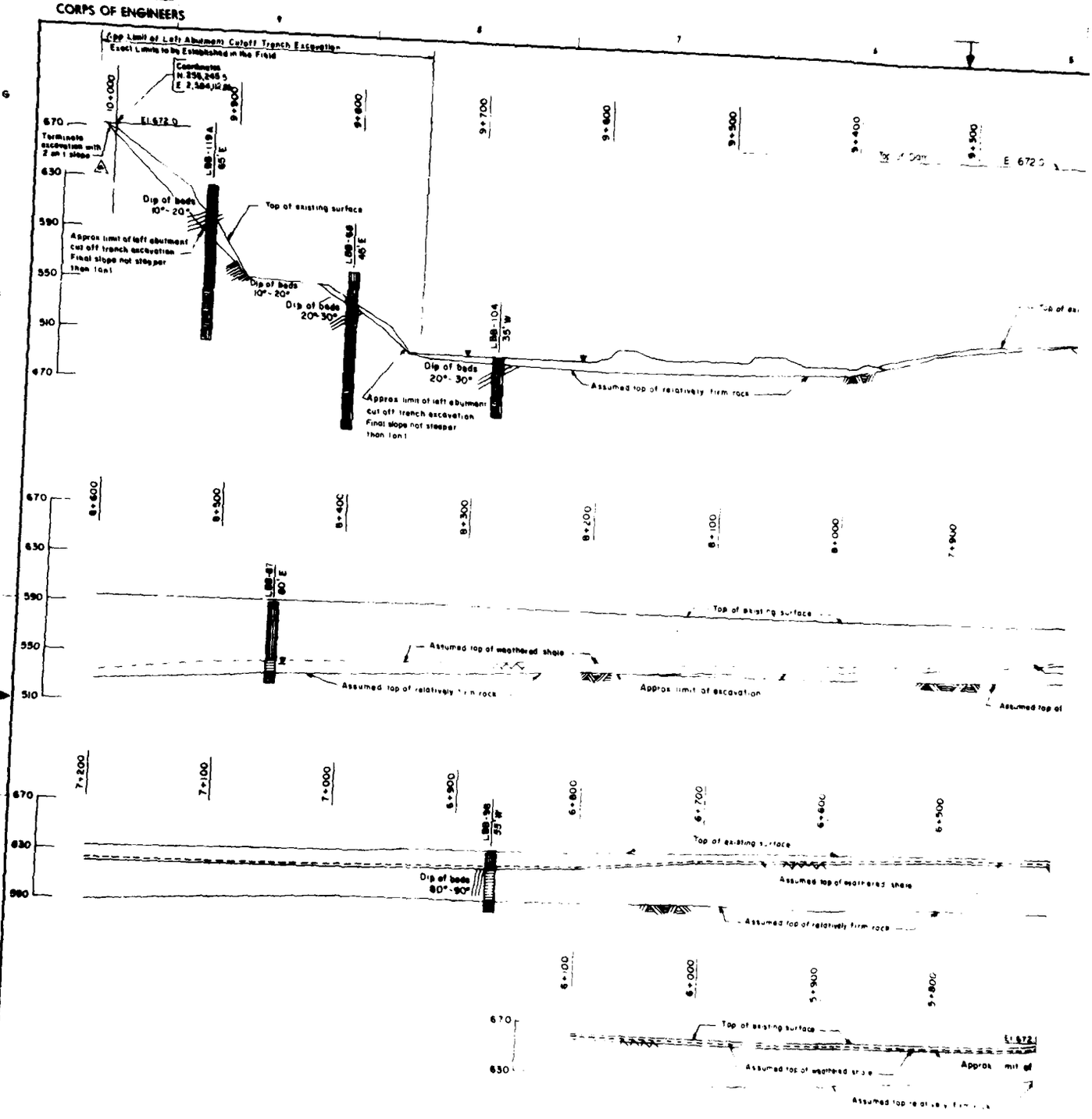



PLATE 21

CORPS OF ENGINEERS



U.S. ARMY

REVISIONS

Top of Dam

El 672.0

9+400 9+300 9+200 9+150.05 9+100 9+000 8+900 8+700 8+600

CONDUIT

LBB-194 15' E

Top of existing surface

Dip of beds 20°

Approx limit of excavation

LBB-6 58' W

Dip of beds 40°

Top of existing surface

LBB-848 50' E

Assumed top of

670 630 590 550 510

8+000 7+900 7+800 7+700 7+600 7+500 7+400 7+300 7+200

LBB-9 65' W

Dip of beds 45°

Approx limit of excavation

Assumed top of weathered shale

Assumed top of relatively firm rock

670 630 590 550

6+600 6+500 6+400 6+300 6+200 6+100

Assumed top of weathered shale

Approx limit of excavation

Assumed top of relatively firm rock

670 630 590

LEGEND

Alluvium

Overburden

Bedrock

Shale

Devonian Mahantango and Trimmers Rock formations

RIGHT ABUTMENT

Coordinates
N 259,328.02
E 2,582,774.15

5+900 5+800 5+700 5+703.6

Existing surface

El 672.0

Approx limit of excavation

Assumed top of weathered shale

Assumed top relatively firm rock

670 630

AS BUILT. DAM

DAM

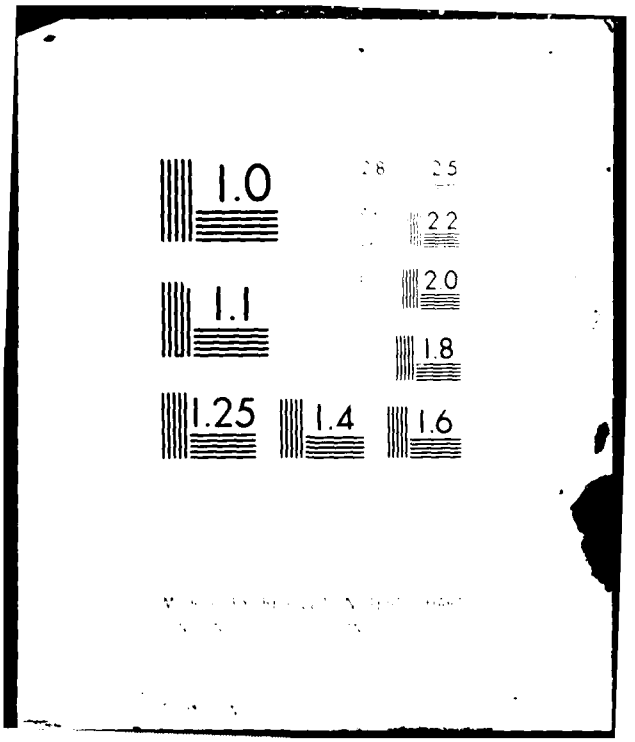
GEOLOGICAL PROFILE ON AXIS OF DAM

PLATE 22

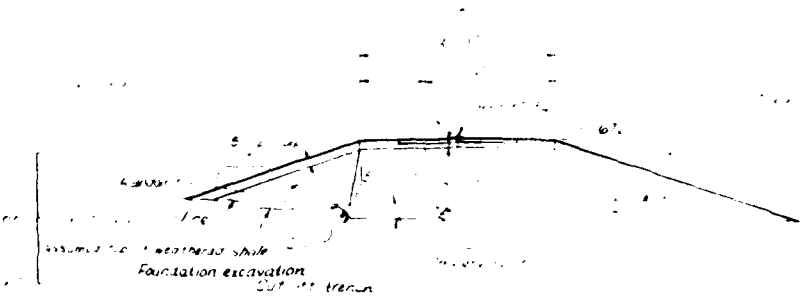
AD-A112 182 ARMY ENGINEER DISTRICT PHILADELPHIA PA F/G 13/13
BELTZVILLE LAKE CONDITION REPORT, DAM, OUTLET WORKS AND SPILLWA--ETC(U)
JUN 74
UNCLASSIFIED DAEN/NAP-01340/PIR0304-74 NL

2 OF 2
AD A
112182

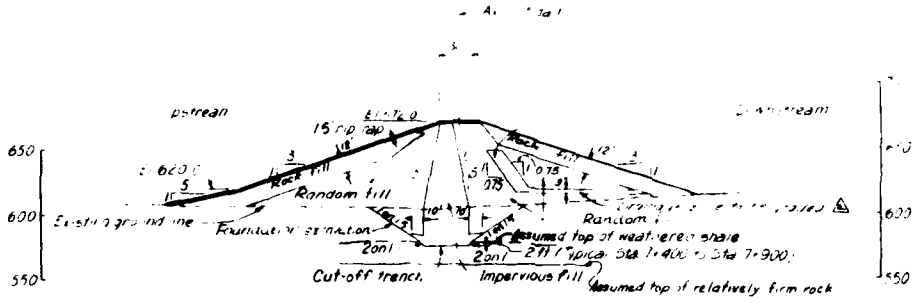
END
DATE
FILMED
04-82
DTIC


1.0
2.8
2.5
2.2
2.0
1.1
1.8
1.25
1.4
1.6

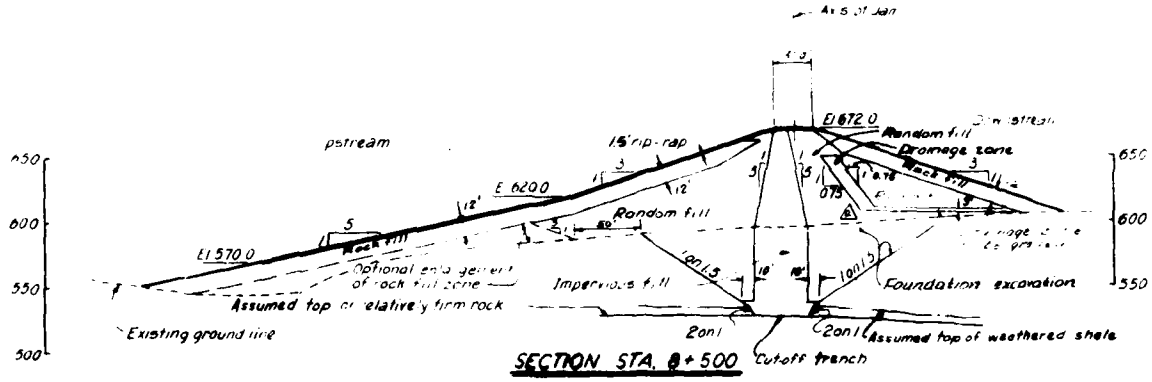
CORPS OF ENGINEERS



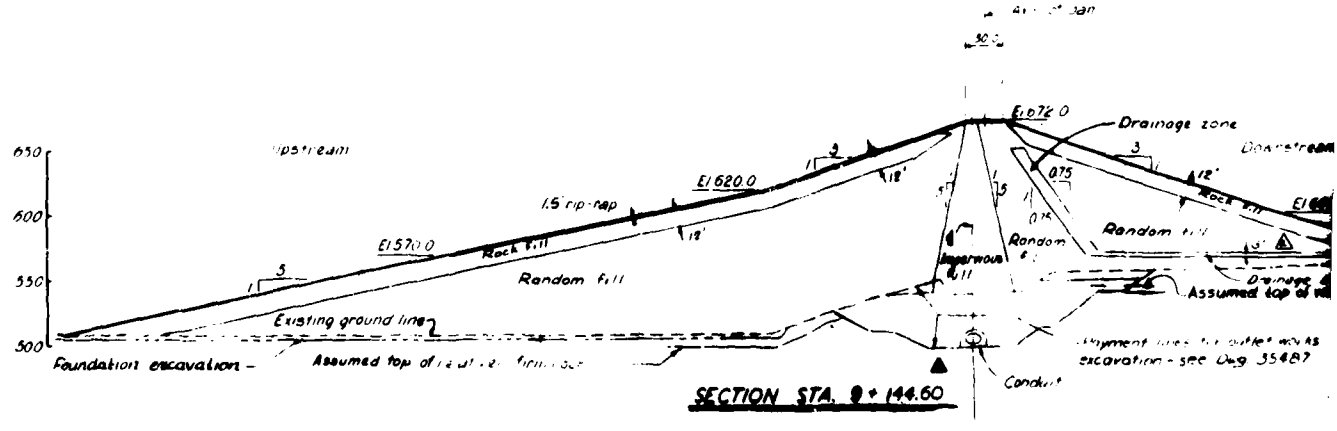

SECTION STA. 6+000




SECTION STA. 7+770




SECTION STA. 8+500

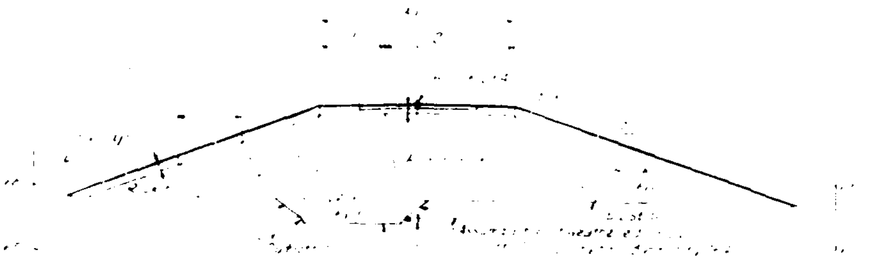



SECTION STA. 9+144.60

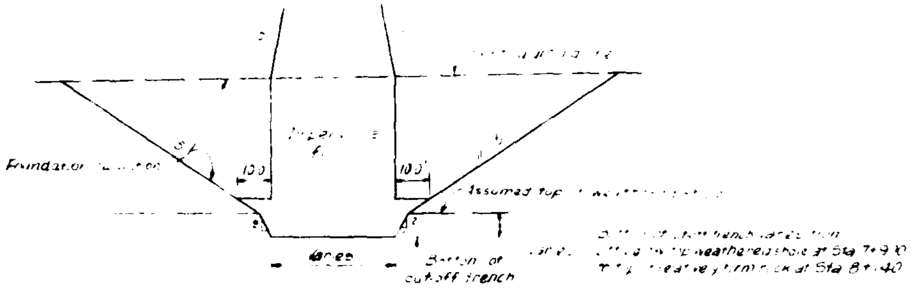
CUT-OFF TRENCH

U.S. ARMY

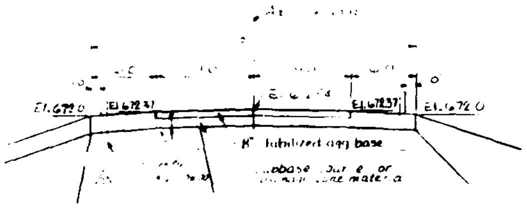
REVISIONS



SECTION STA 6+500

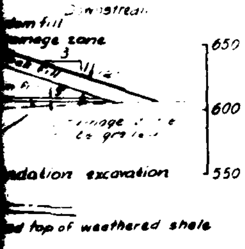


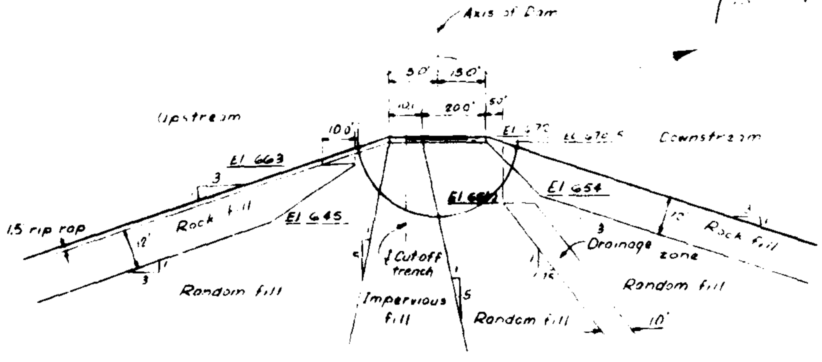
CUT-OFF TRENCH DETAIL STA. 7+900 TO 8+140



ROAD DETAIL

SCALE: 1"=60'

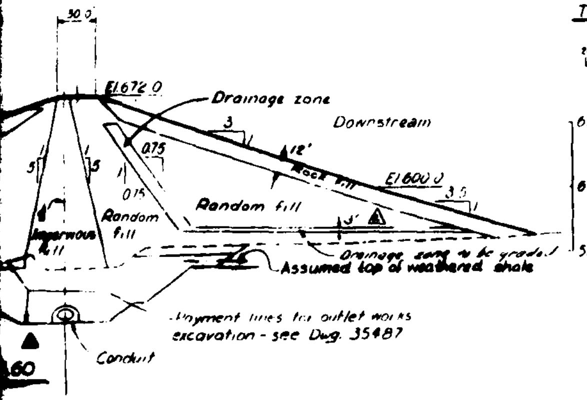




TOP OF DAM DETAIL

SCALE 1"=20'

20 10 0 20 40 FT



NOTES:

1 Work this drawing with 354

SCALE 1"=50'

50 25 0 50 100 FT

Except as noted

BUILT MAR

CONTRACT No DACW 61-67 C-0024

S. ARMY ENGINEER DISTRICT, PHILADELPHIA
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER

**DAM**

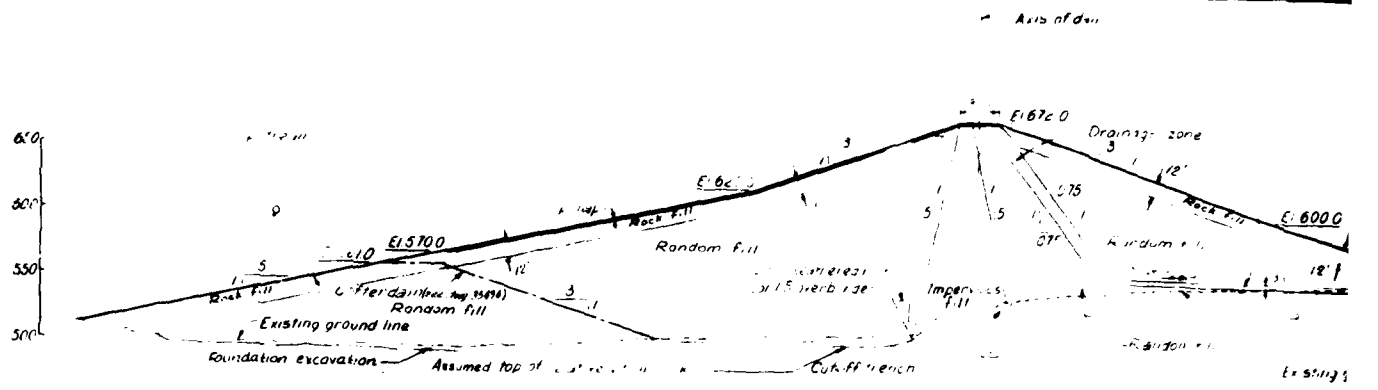
TYPICAL SECTIONS - SHEET 1

F

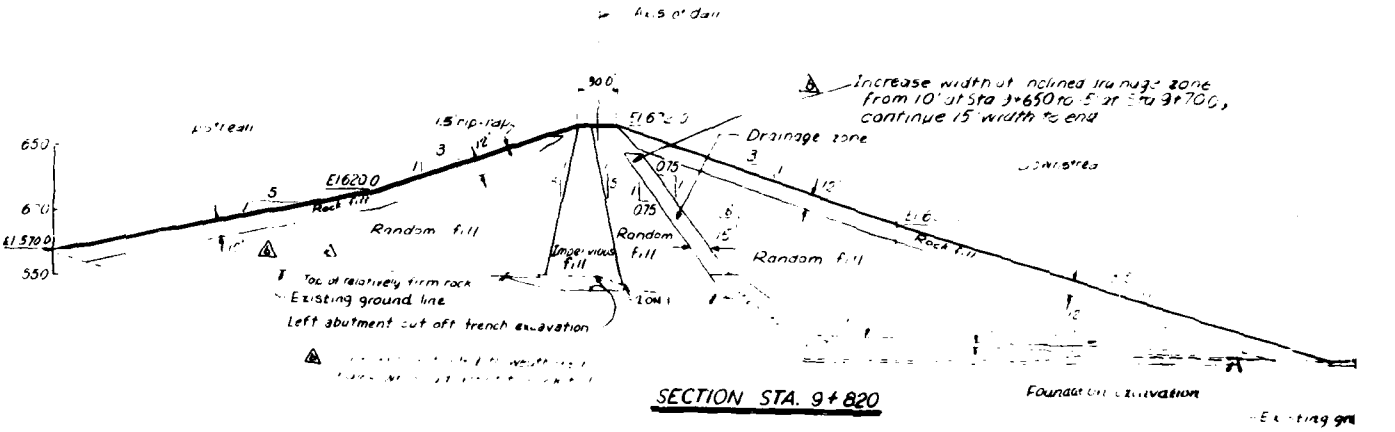
35491

PLATE 23

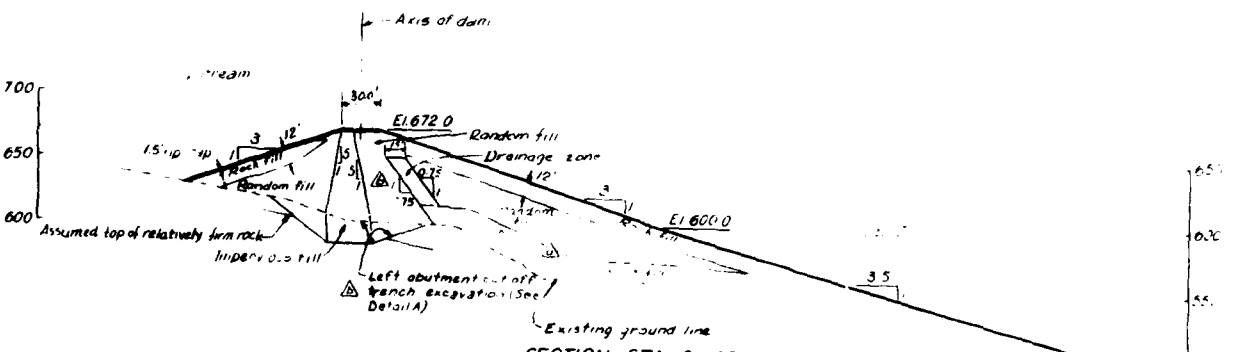
CORPS OF ENGINEERS



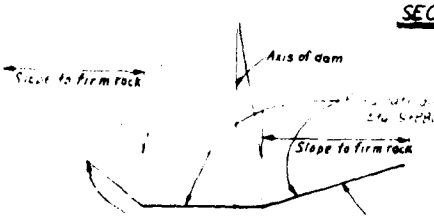

SECTION STA. 9+280




SECTION STA. 9+820




SECTION STA. 9+920




DETAIL A

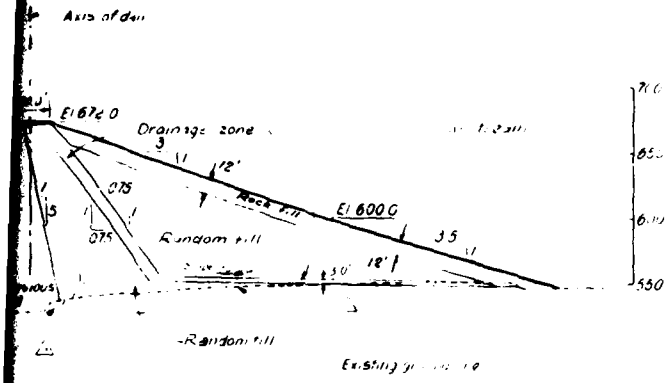
Scale 1" = 20'

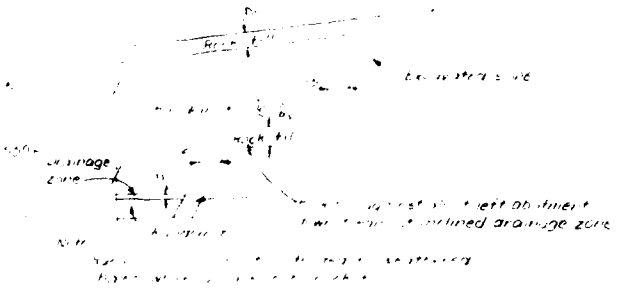
Cutoff trench slopes Sta 9+880± to 9+985±. Steepen to end, Sta 9+985± to end

See separate report on pneumatically placed concrete ... record of site.

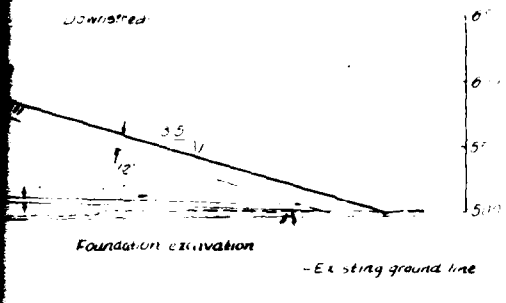
U.S. ARMY

REVISIONS




SECTION A-A





NOTES

U.S. ARMY ENGINEER DISTRICT, PHILADELPHIA
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER

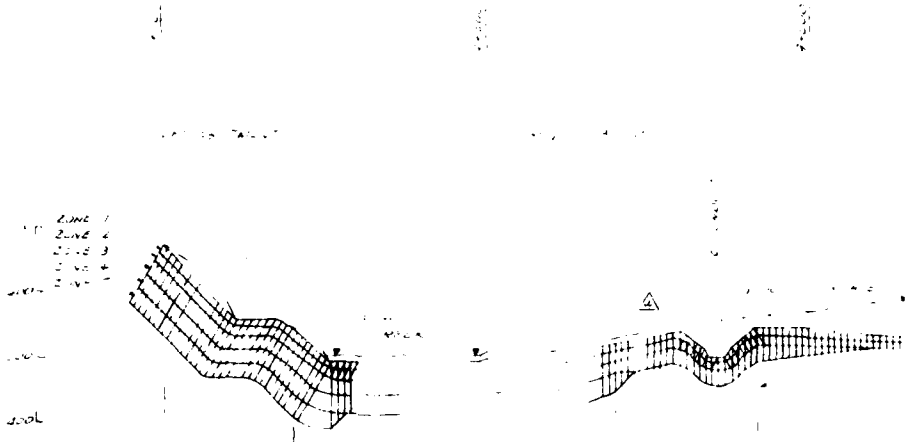
DAM

TYPICAL SECTIONS - SHEET 2

35492

PLATE 24

CORPS OF ENGINEERS



ANGLE HOLES UP TO 100' DEEP
ON C LINE 25' DEEP ON A & B LINE

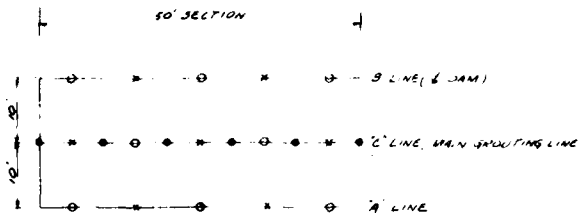
ALL HOLES ON C LINE 100' DEEP
ALL HOLES VERTICAL A & B LINE
HOLES 25' DEEP

ANGLE HOLES ON C LINE UP TO 100' DEEP
PRIMARY HOLES ON A & B 25' DEEP
SECONDARY HOLES ARE
AN A & B LINE AND 25' DEEP
IN THE VALLEY HOLES ON C LINE TRANSITIONAL
FROM 100'

TRANSITIONAL HOLES
CONTACT GROUTING
AROUND OUTLET WORKS
GROUT HOLES IN THE CONDUIT AREA SHALL BE CROSS-CHECKED

## PROFILE ALONG DAM ℄

SCALE 1" = 100'-0"

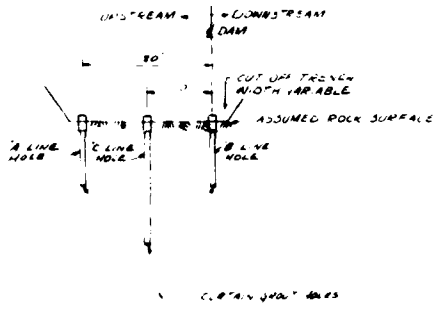



## MULTIPLE LINE GROUTING PLAN

SCALE 1" = 12'-0"

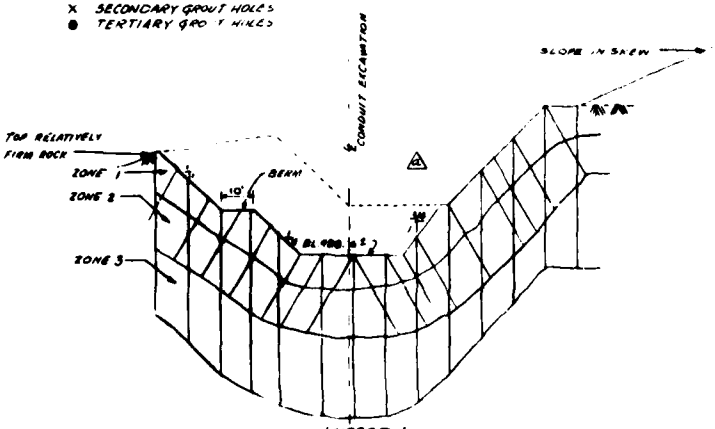
LEGEND

- O PRIMARY GROUT HOLES
- X SECONDARY GROUT HOLES
- ● TERTIARY GROUT HOLES




## TYPICAL SECTION

NOT TO SCALE




## INSERT 1

SCALE 1" = 20'-0"

SECTION TAKEN PERPENDICULAR TO CENTERLINE OF CONDUIT

NOTES

THE DRILLING AND
FOLLOWING RULE
WILL BE DETERMI

TEST GROUTING
IN THE FOLLOWING
AREA 'A' STA 9+
AREA 'C' STA 9+
THE RESULTS OF

EXTENDS ON PAR
AND SHALL BE
ALL PRIMARY AN
AND GRAVITY GR

U S ARMY

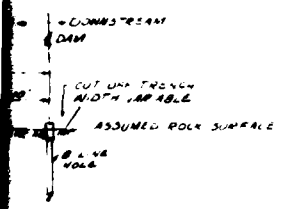
| REVISIONS | | | | |
|---|---|---|---|---|
| SYM | ZONE | DESCRIPTION | DATE | APPD |
| | | | | |
| | | | | |

HOLES FROM 50' TO 25' DEEP
AND 25 TO 10' ON A & B LINES

ON C LINE FROM 75 TO 50' DEEP
THROUGH 3 PIPES EMBEDDED IN CONCRETE
(SEE DETAIL SEE DWG NO 35699)
CONDUIT AREA SHALL BE CROSS-CROSSED

## PROFILE ALONG DAM ℄

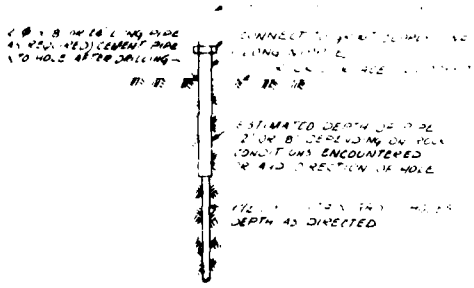
SCALE 1" = 100'-0"




CURTAIN GROUT HOLES

## SECTION

TO SCALE




## GROUT PIPE DETAIL

SCALE 1" = 1'-0"

EXTENSION PIPE WHERE REQUIRED

NOTES

1. THE SPACING AND DEPTH OF HOLES FOR THE CURTAIN GROUTING ARE SHOWN FOR PURPOSE OF ILLUSTRATION. THE ACTUAL SPACING AND DEPTH OF HOLES WILL BE DETERMINED BY THE CONTRACTING OFFICER AS THE WORK PROGRESSES.
2. TEST GROUTING HAS BEEN PERFORMED BY THE CONTRACTING OFFICER IN 4 AREAS IN THE FOLLOWING AREAS.
   AREA "A" STA 9+890 TO STA 9+865, AREA "B" STA 9+250 TO STA 9+300
   AREA "C" STA 9+080 TO STA 9+130.
   THE RESULTS OF TEST GROUTING ARE AVAILABLE
3. EXTENSION PIPE 1FT LONG SHALL BE REQUIRED FOR ESVE GROUTING AS NEEDED AND SHALL BE CONNECTED TO THE NIPPLE PRIOR TO STARTING GROUTING
4. ALL PRIMARY AND SECONDARY HOLES "A, B" LINES STA 3+250 DRILLED FROM 5 AND GRAVITY GROUTED

SEE GROUTING RECORDS - PART OF PERMANENT RECORDS AT DAM SITE

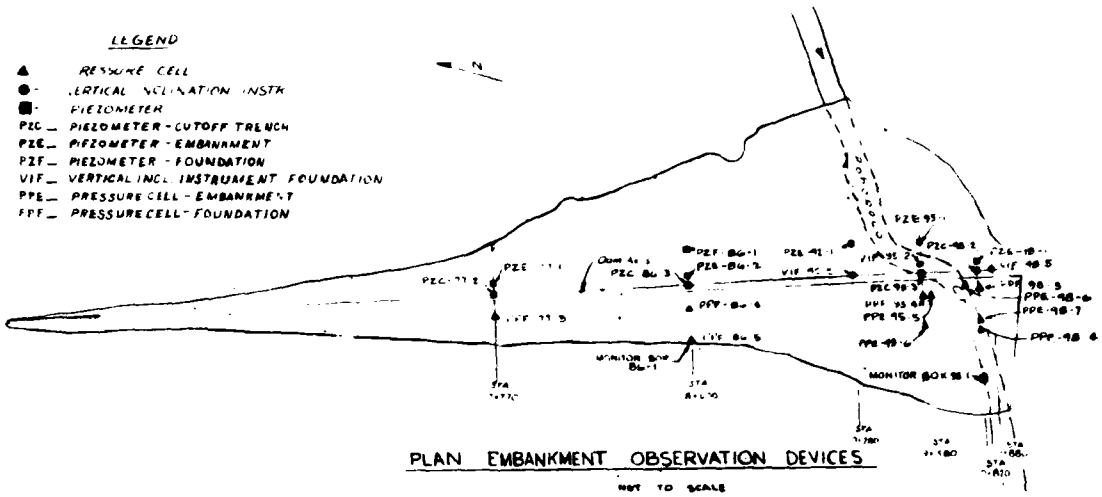
AS-BUILT. MAR 11 1971 DATE

| | | |
|---|---|---|
| DESIGN BY R. Lodor | TRACED BY G.D. | U S ARMY ENGINEER DISTRICT, PHILADELPHIA<br>CORPS OF ENGINEERS<br>OFFICE OF THE DISTRICT ENGINEER |
| | | LEHIGH RIVER BASIN<br>BELTZVILLE DAM AND RESERVOIR |
| | | DAM |
| | | GROUTING PLAN & DETAILS |
| DATE 5/17/67 | REV F | REV NO. DATE 11-17-70 | DRAWING NO 35495 |
| | DRAWN AS SHOWN | SHEET 20 |

CONTRACT NO DACW 61-67-C-0224

PLATE 25

CORPS OF ENGINEERS




PLAN EMBANKMENT OBSERVATION DEVICES

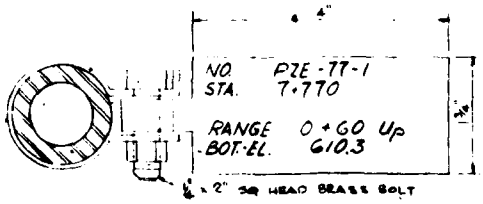
NOT TO SCALE


TYPICAL SECTION STATION 8+600

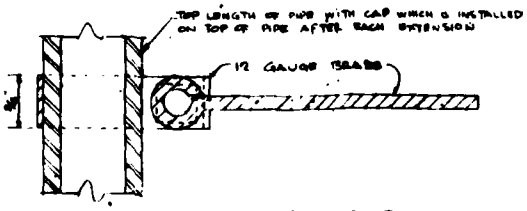
SCALE 1"=50'

| GAGE NO. | STATION | RANGE | ELEVATION | MATERIAL | TYPE OF INSTALLATION |
|---|---|---|---|---|---|
| PZE-77-1 | 7+770 | 0+60 UP | 610.3 | EMBANKMENT | PIEZOMETER |
| PZC-77-2 | 7+770 | 0+17 UP | 578.3 | CUTOFF TRENCH | " |
| PPF-77-3 | 7+770 | 0+65 DN | 565.4 | FOUNDATION | PRESSURE CELL |
| PZF-86-1 | 8+600 | 1+35 UP | 551.5 | " | PIEZOMETER |
| PZE-86-2 | 8+600 | 0+60 UP | 596.6 | EMBANKMENT | " |
| PZC-86-3 | 8+600 | 0+17 UP | 523.0 | CUTOFF TRENCH | " |
| PPF-86-4 | 8+600 | 0+85 DN | 532.5 | FOUNDATION | PRESSURE CELL |
| PPF-86-5 | 8+600 | 1+90 DN | 579.5 | " | " " |
| PZE-98-1 | 9+880 | 1+35 UP | 613.1 | EMBANKMENT | PIEZOMETER |
| VIF-98-2 | 9+880 | 0+17 UP | 515.5 | FOUNDATION | VERT. INSTR. |
| PZE-95-1 | 9+880 | 1+35 UP | 606.5 | EMBANKMENT | PIEZOMETER |
| VIF-98-2 | 9+880 | 0+80 UP | 598.5 | FOUNDATION | VERT. INSTR. |
| PZC-98-3 | 9+880 | 0+17 UP | 501.8 | CUTOFF TRENCH | PIEZOMETER |
| PPF-98-4 | 9+880 | 0+80 DN | 482.2 | FOUNDATION | PRESSURE CELL |
| VIF-98-5 | 9+880 | 0+60 UP | 565.5 | EMBANKMENT | PIEZOMETER |
| PZC-98-2 | 9+880 | 0+17 UP | 552.0 | CUTOFF TRENCH | " |
| PPE-98-5 | 9+880 | 0+80 DN | 520.2 | FOUNDATION | PRESSURE CELL |
| PPF-98-4 | 9+880 | 0+70 DN | 496.8 | " | " |
| VIF-98-5 | 9+880 | 0+17 UP | 550.0 | " | VERT. INSTR. |
| PPE-98-5 | 9+890 | 0+80 DN | 520.2 | EMBANKMENT | PRESSURE CELL |
| PPE-98-6 | 9+880 | 1+80 DN | 523.8 | " | " |
| PPE-98-6 | 9+890 | 0+80 DN | 510.2 | " | " |
| PPE-98-7 | 9+880 | 1+90 DN | 510.2 | " | " |

| MONITOR BOX INSTALLATIONS | | | |
|---|---|---|---|
| BOX NO. | STATION | GAUGE (REFERENCE WALL) | EL TOP OF BOX |
| BOX 86-1 | 8+600 | 1+96.00 | 611.5 |
| BOX 98-1 | 9+880 | 0+82.5 DN | 526.5 |



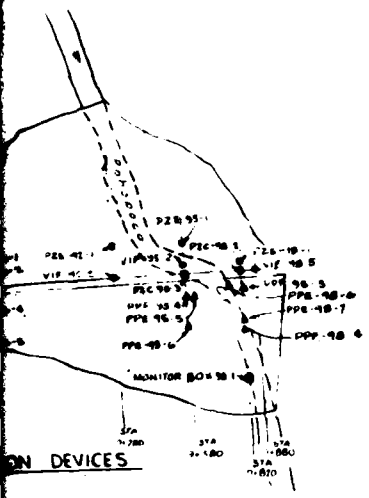

NOTE: IDENTIFICATION TAGS WILL BE PLACED ON ALL PIEZOMETER & VERTICAL INCLINATION INSTALLATIONS.



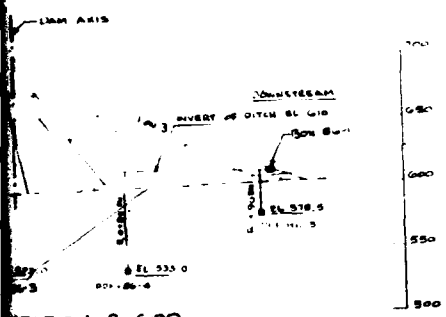

DETAIL OF IDENTIFICATION TAG

NOT TO SCALE

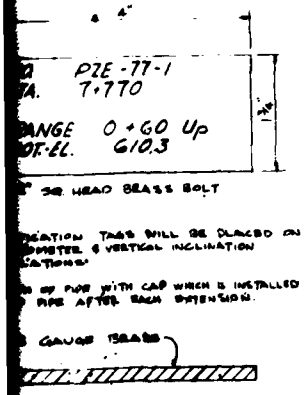
U. S. ARMY



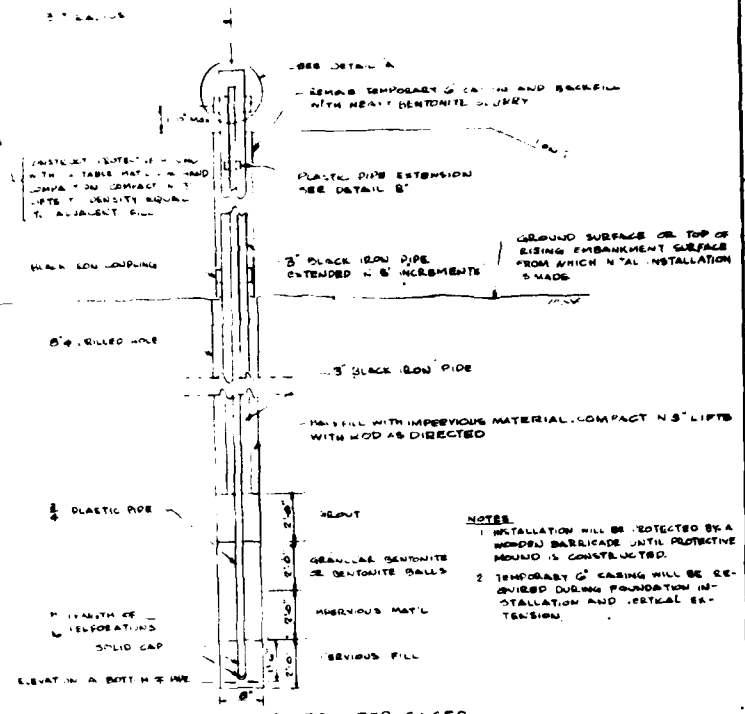

ON DEVICES




STATION 8+600

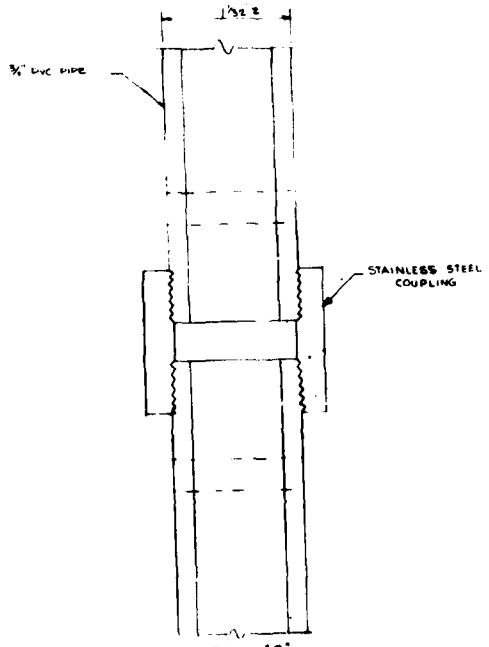



NTIFICATION TAG

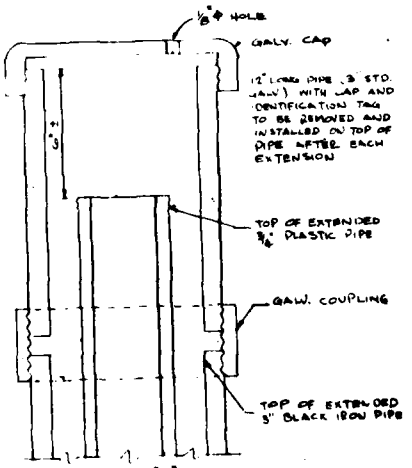



NOTES
1. INSTALLATION WILL BE PROTECTED BY A WOODEN BARRICADE UNTIL PROTECTIVE MOUND IS CONSTRUCTED.
2. TEMPORARY 6" CASING WILL BE REQUIRED DURING FOUNDATION INSTALLATION AND VERTICAL EXTENSION.

PORE PRESSURE - PIEZOMETER GAGES
FOUNDATION INSTALLATION & EXTENSION
NOT TO SCALE




DETAIL "B"
PLASTIC PIPE EXTENSION
NOT TO SCALE




DETAIL "A"
NOT TO SCALE

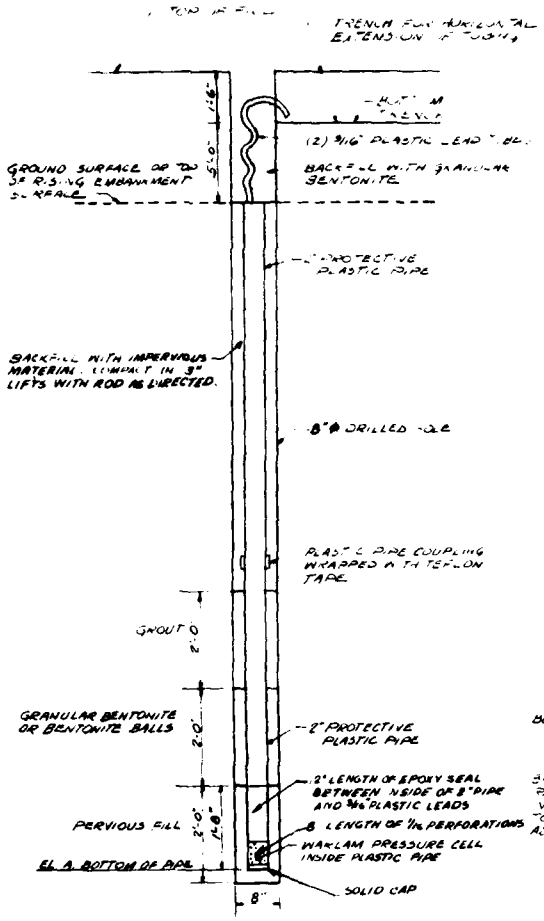
U. S. ARMY ENGINEER DISTRICT, PHILADELPHIA
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER

INSTRUMENTATION
PLAN AND DETAILS

35496

PLATE 28

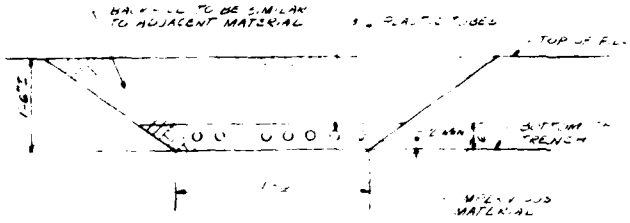
CORPS OF ENGINEERS




**PRESSURE CELLS-INSTALLATION**

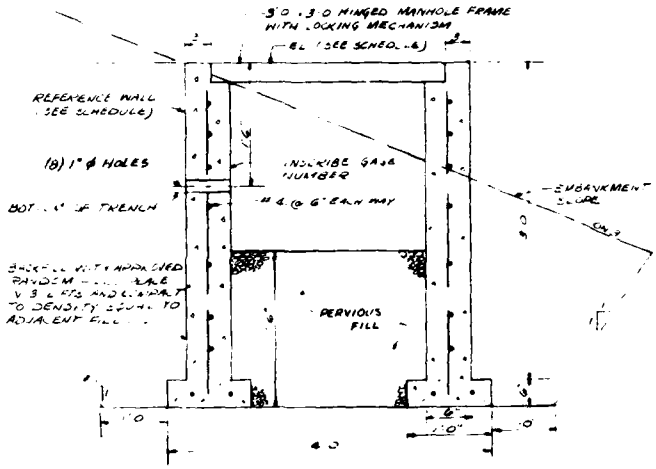
NOT TO SCALE

NOTE
TEMPORARY 6" CASING WILL BE REQUIRED DURING INSTALLATION



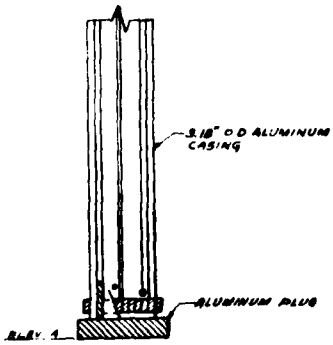

**TYPICAL SECTION**
**EXCAVATION FOR PRESSURE CELL TUBING**

NOT TO SCALE



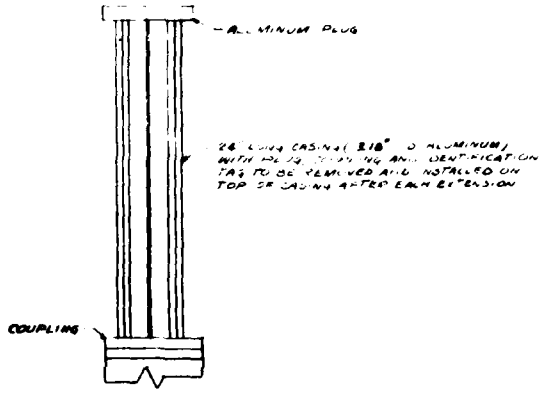

**CONCRETE MONITORING BOXES**

NOT TO SCALE



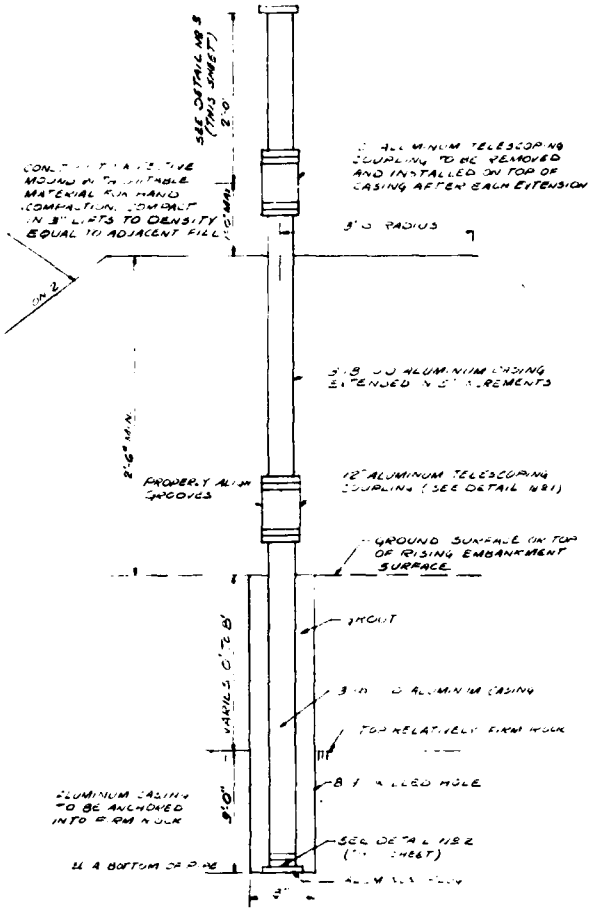

**DETAIL NO. 2**

NOT TO SCALE

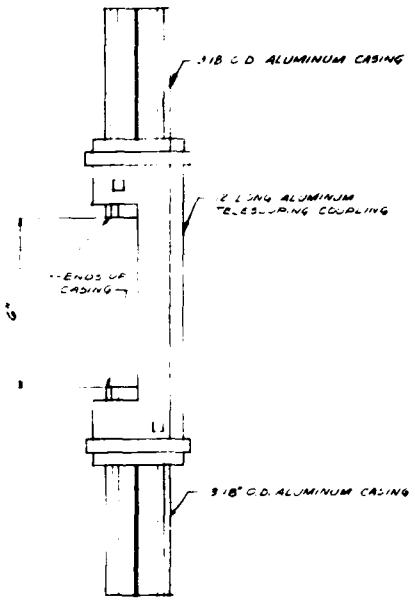



**DETAIL NO. 3**

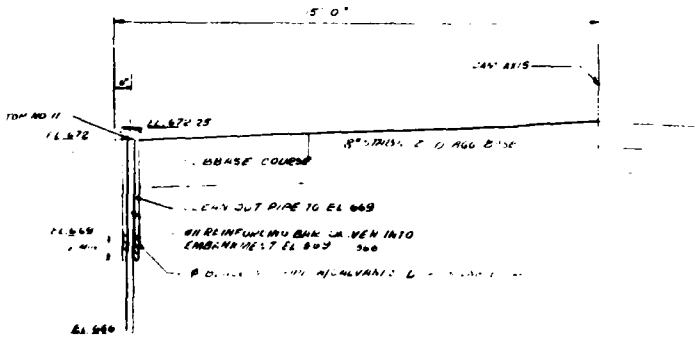
NOT TO SCALE


VERTICAL INCLINATION INSTRUMENT INSTALLATION




DETAIL NO. 1




SURFACE SETTLEMENT PIPES

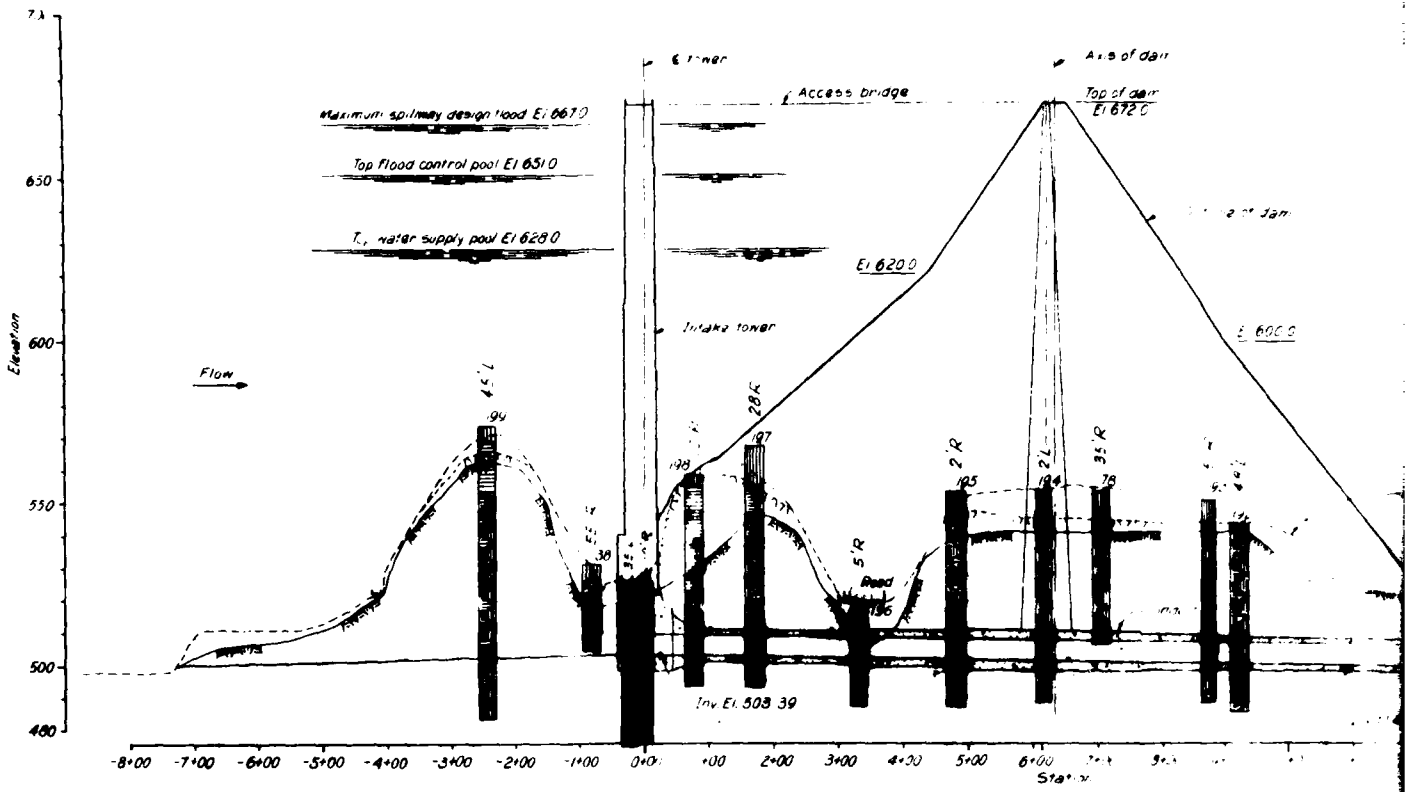
SCALE 1" = 2'

| SURFACE SETTLEMENT PIPE INSTALLATIONS | | |
|---|---|---|
| PIPE NO | STATION | RANGE |
| SP-1 | 6+000 | [illegible] |
| SP-2 | 7+000 | [illegible] |
| SP-3 | 7+500 | [illegible] |
| SP-4 | 8+000 | [illegible] |
| SP-5 | 8+500 | [illegible] |
| SP-6 | 9+000 | [illegible] |
| SP-7 | 9+500 | [illegible] |

U. S. ARMY ENGINEER DISTRICT, PHILADELPHIA
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER

INSTRUMENTATION DETAILS

35497

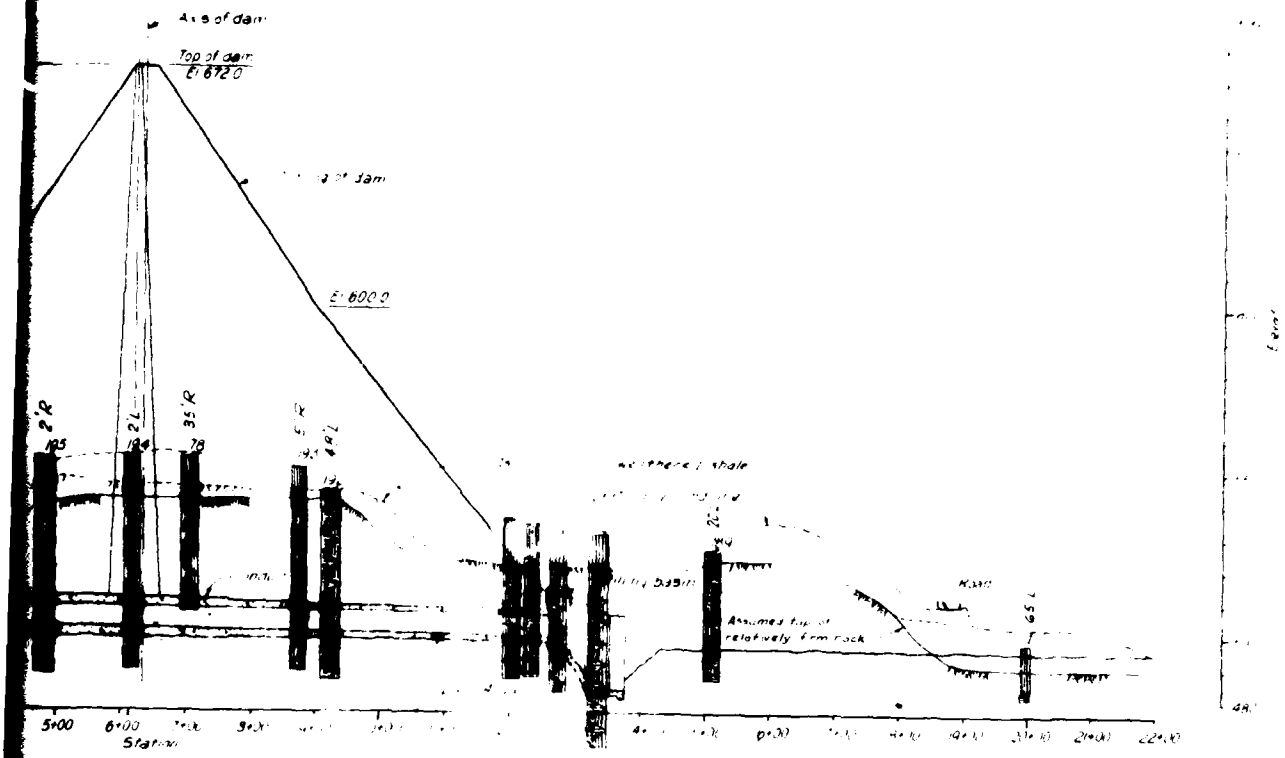



PROFILE ON ℄ CONDUIT

Horizontal scale
Vertical scale

U.S. ARMY 4

REVISIONS




PROFILE ON ℄ CONDUIT

Horizontal scale 1"=100'-0"
Vertical scale 1"=20'-0"

## LEGEND

| | | | |
|---|---|---|---|
| Overburden | ALLUVIUM | Recent deposits consisting of pervious sands, gravels and occasional boulders | |
| | DRIFT | Glacially deposited heterogeneous mixture of [illegible] through boulders, compact | |
| | OUTWASH | Glacial, predominantly stratified, sands and silty sands loose. | |
| Bedrock | SHALE | Weathered highly fragmental, many clay filled joints | Devonian Mahantango formation |
| | SHALE | Relatively firm, predominantly dk-grey in color some sandstone beds | |

Note: Offset of borings left or right of conduit ℄ - reference to downstream stationing

CONTRACT NO. DACW 61-67-C-[illegible]

OUTLET WORKS
CONDUIT
GEOLOGIC PROFILE ON ℄ CONDUIT

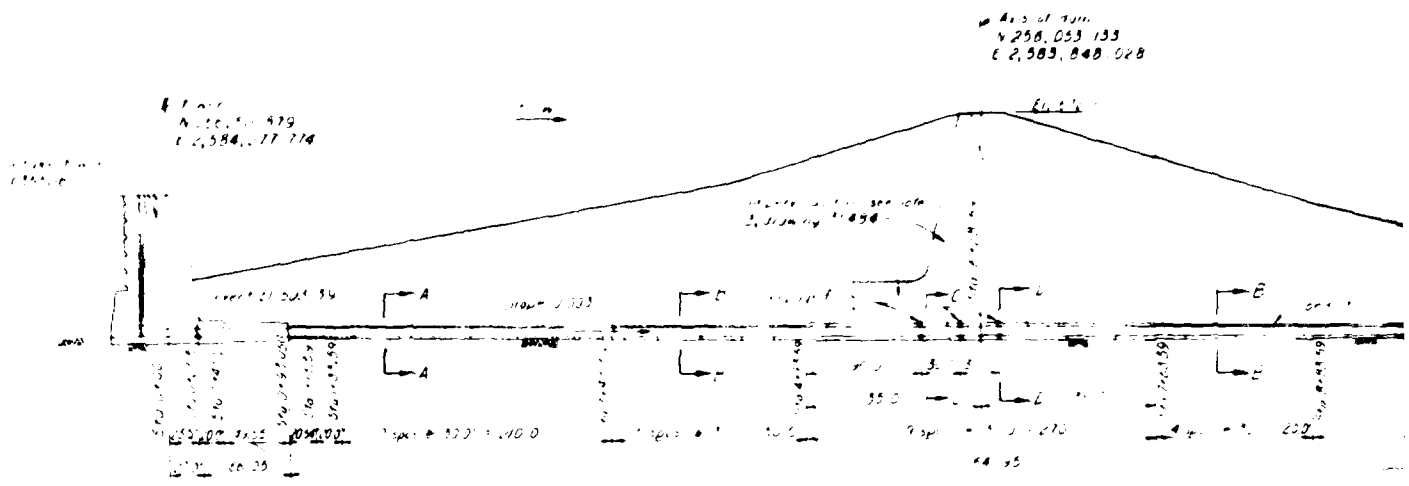
F

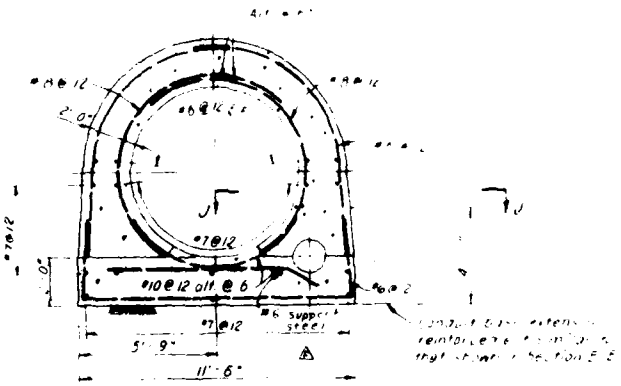
35498

PLATE 28

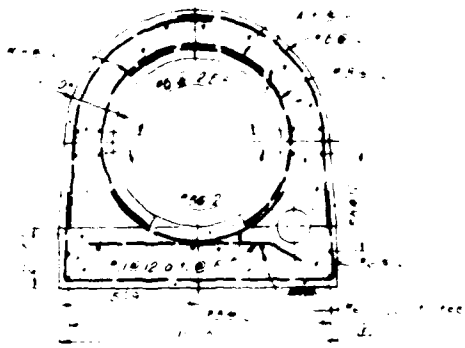
35 mm

CORPS OF ENGINEERS

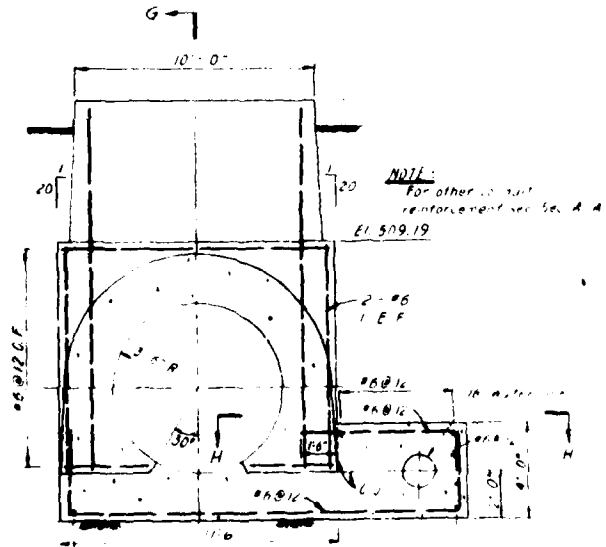




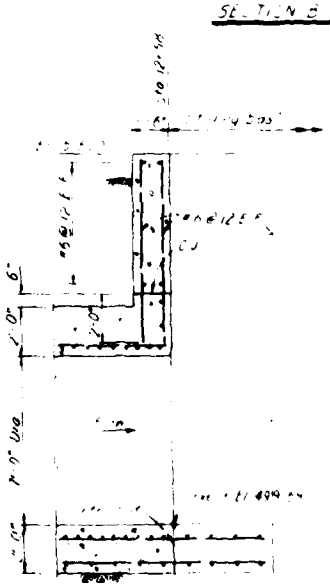

SECTION A-A

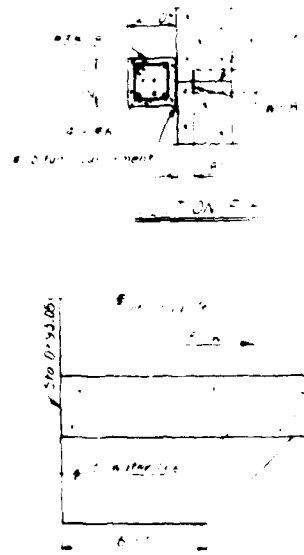


SECTION B-B




SECTION E-E





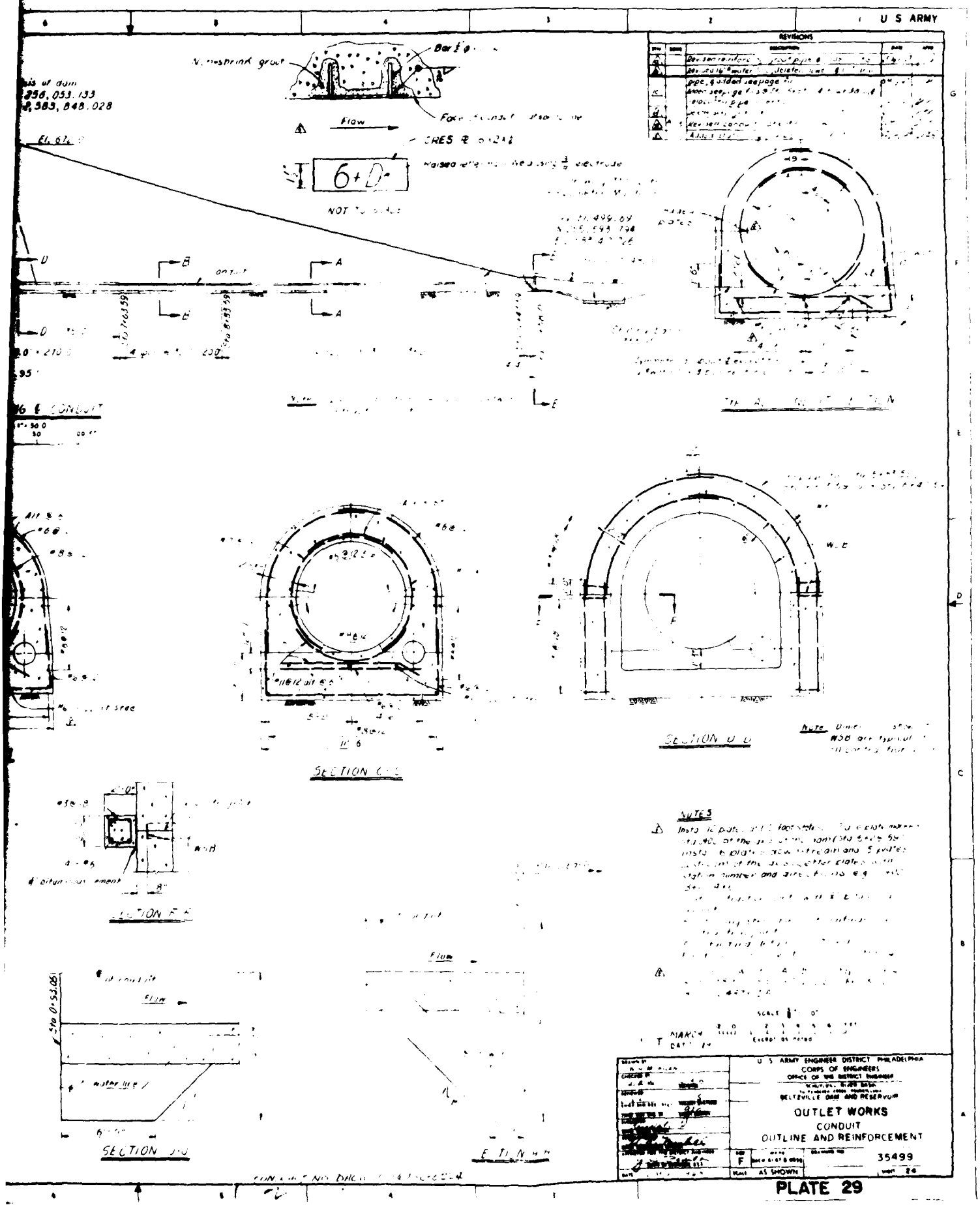
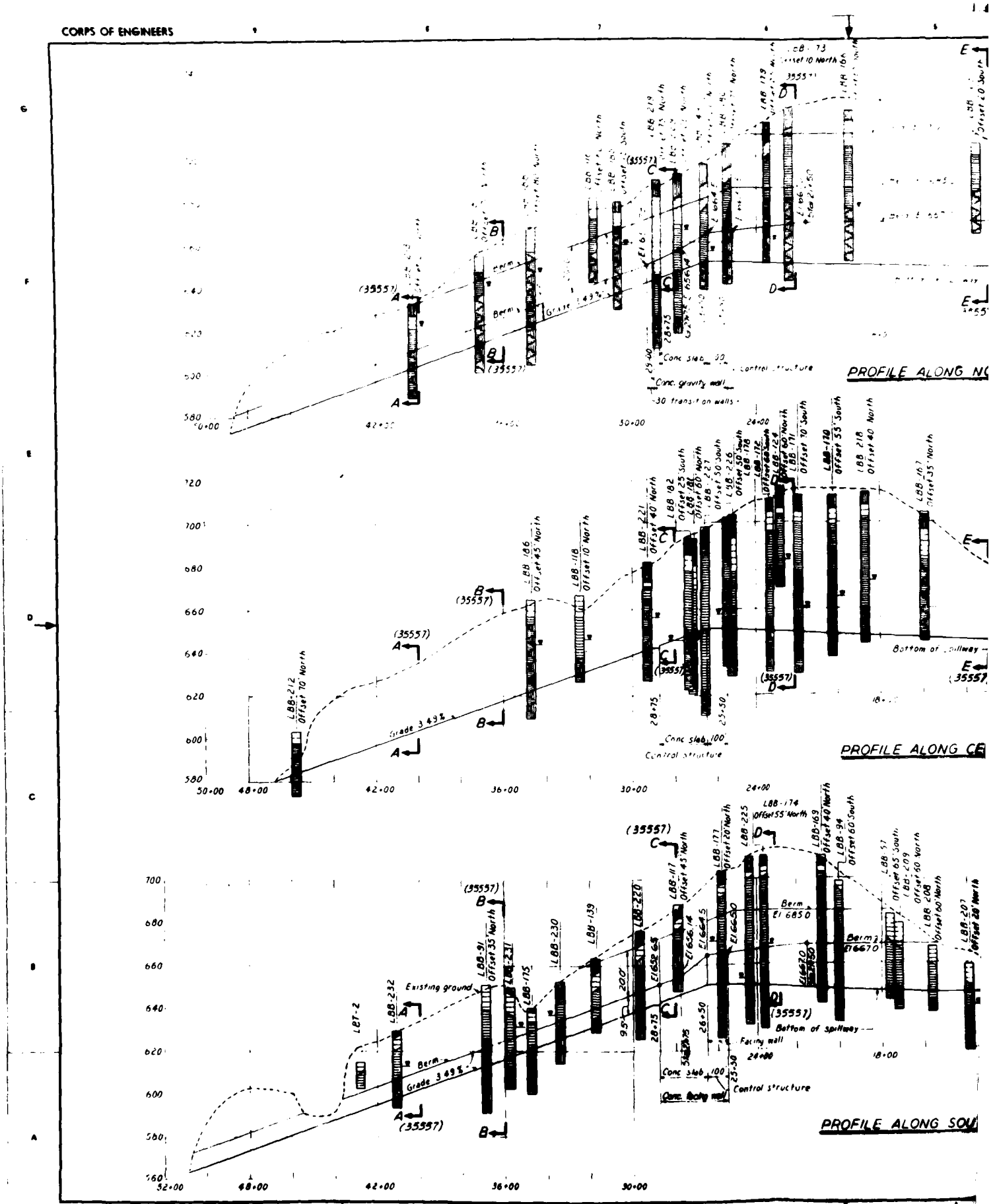

U S ARMY
REVISIONS
Flow
NOT TO SCALE
SECTION
SECTION
SECTION
SECTION
NOTES
SCALE
U S ARMY ENGINEER DISTRICT PHILADELPHIA
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
BELTZVILLE DAM AND RESERVOIR
OUTLET WORKS
CONDUIT
OUTLINE AND REINFORCEMENT
35499
AS SHOWN

PLATE 29

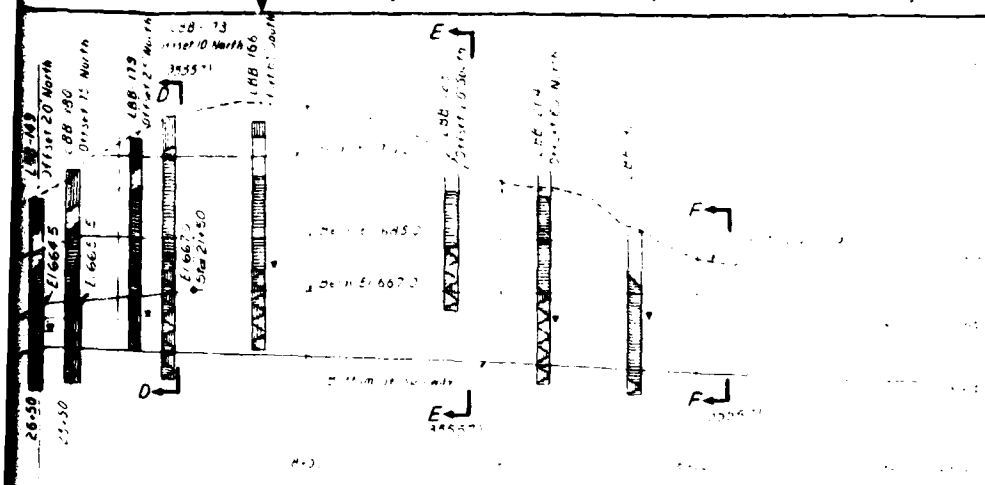
CORPS OF ENGINEERS



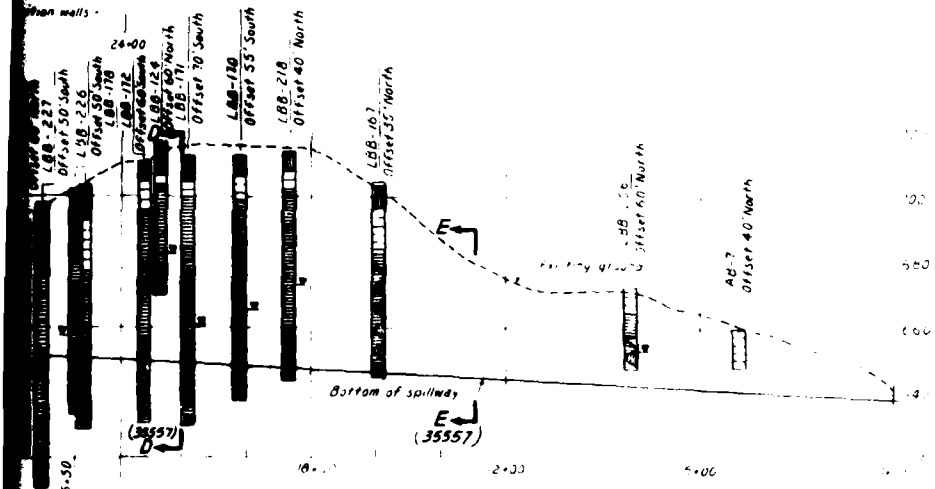
U.S. ARMY

REVISIONS

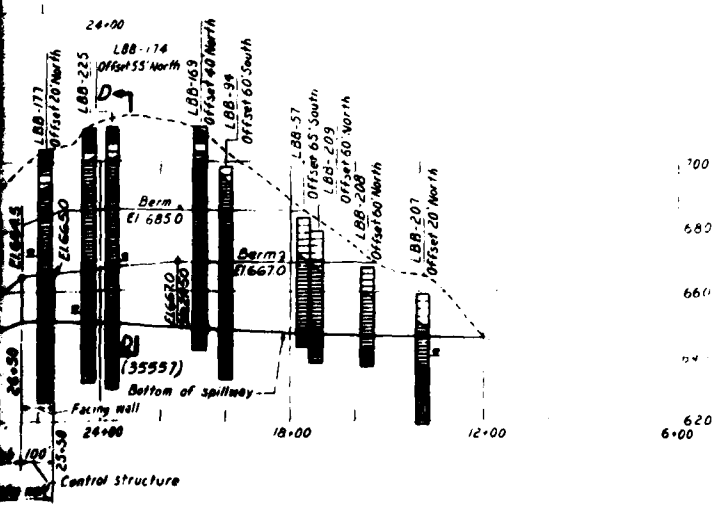
SOUTH EDGE ... DELETED




PROFILE ALONG NORTH EDGE OF SPILLWAY




PROFILE ALONG CENTERLINE OF SPILLWAY




PROFILE ALONG SOUTH EDGE OF SPILLWAY

## SYMBOLS

Alluvial silt, sand and silty gravel, cobbles, some boulders, loose

Residual overburden (decomposed shale siltstone and slate) (Dm)

Partly Weathered Bedrock (shale siltstone, slate; Mahantango Formation Dm)

Firm Relatively Unweathered Bedrock (Shale, siltstone and some slaty shale) (Dm)

## NOTES

Work this drawing with Dwgs 35555, 35556 and 35557.

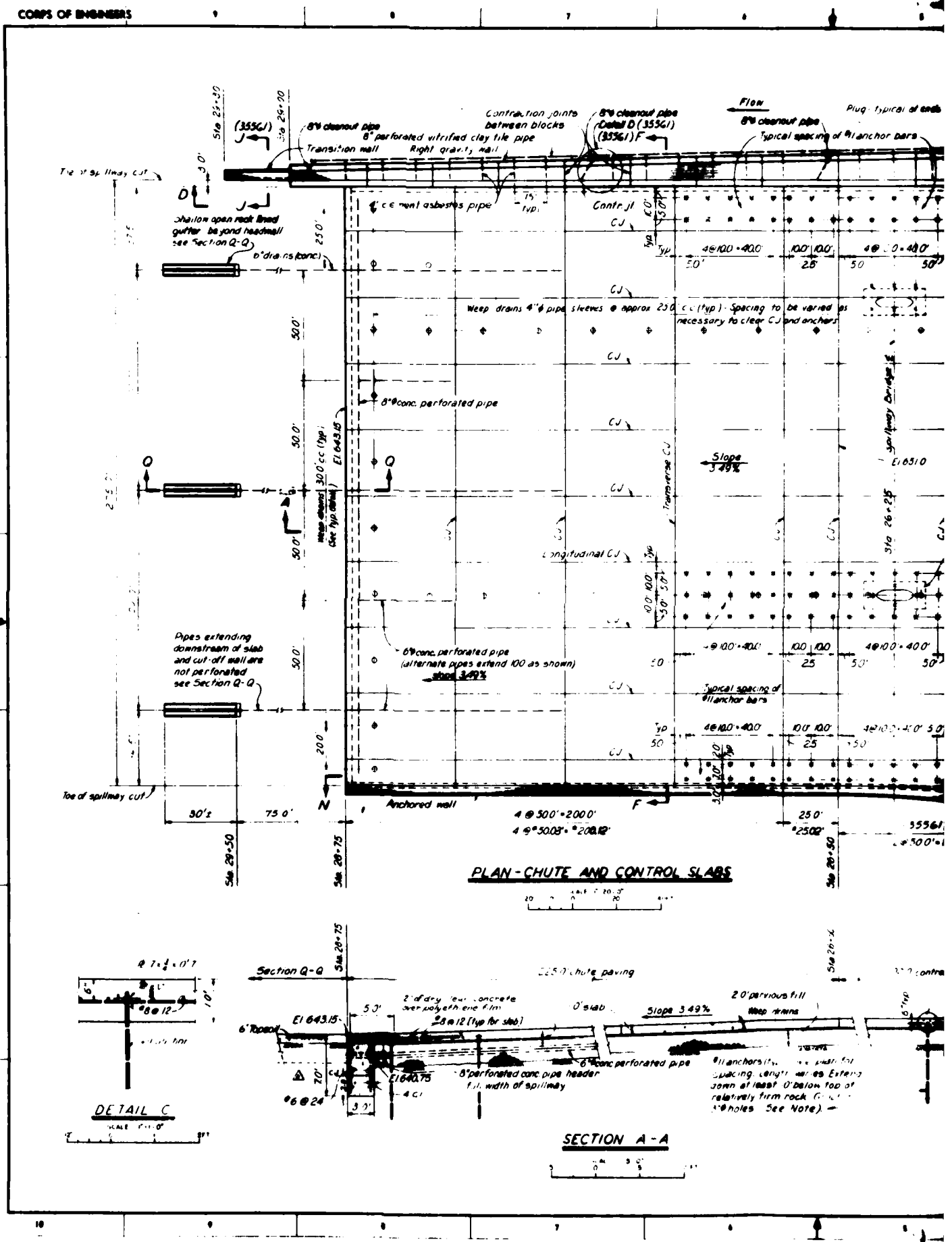
AS BUILT

| | | |
|---|---|---|
| | | SPILLWAY GEOLOGICAL PROFILES SHOWING BERM LOCATIONS |
| | F | 35558 |

CONTRACT NO DACW 31-67-C-0224

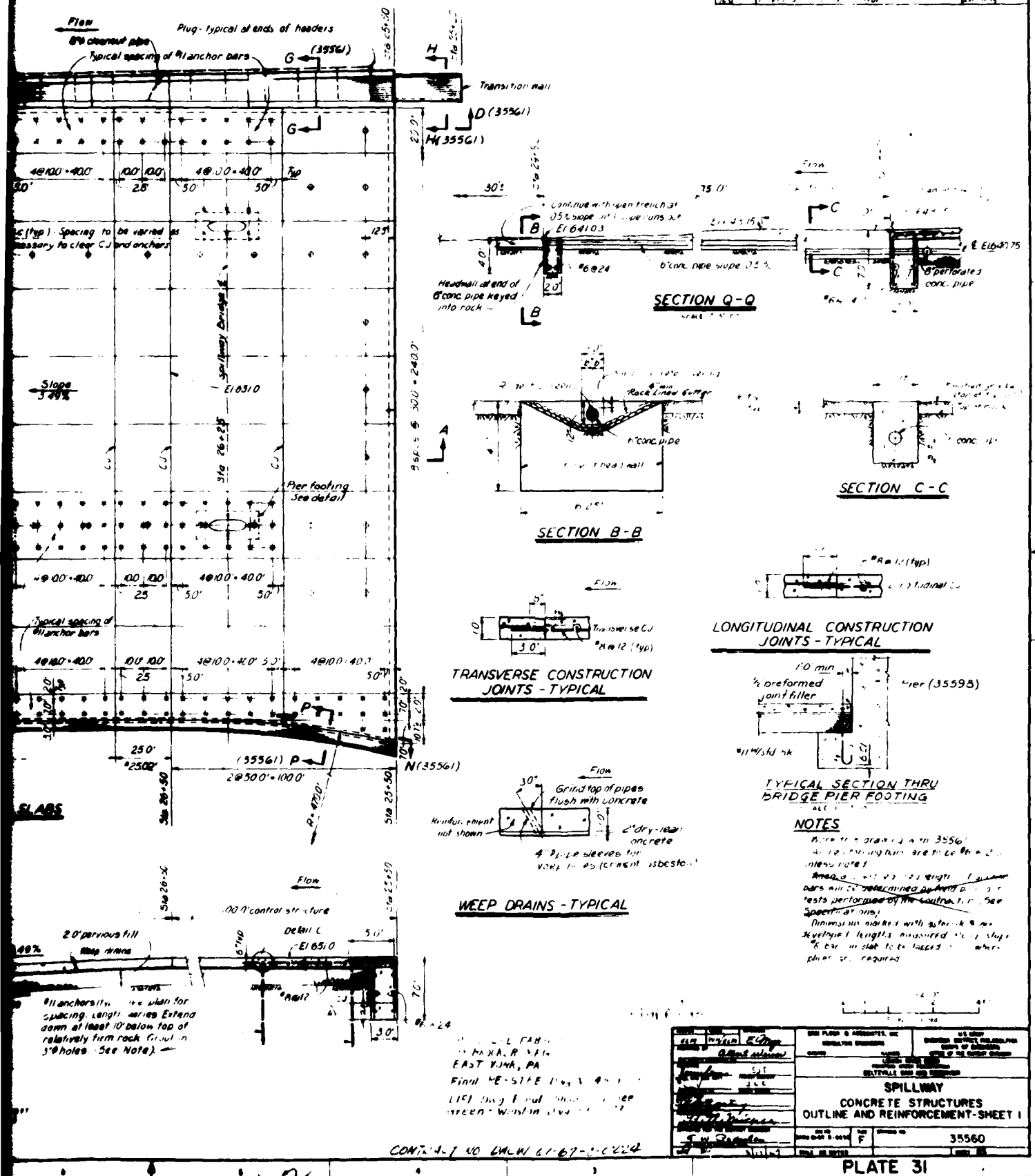
PLATE 30

CORPS OF ENGINEERS

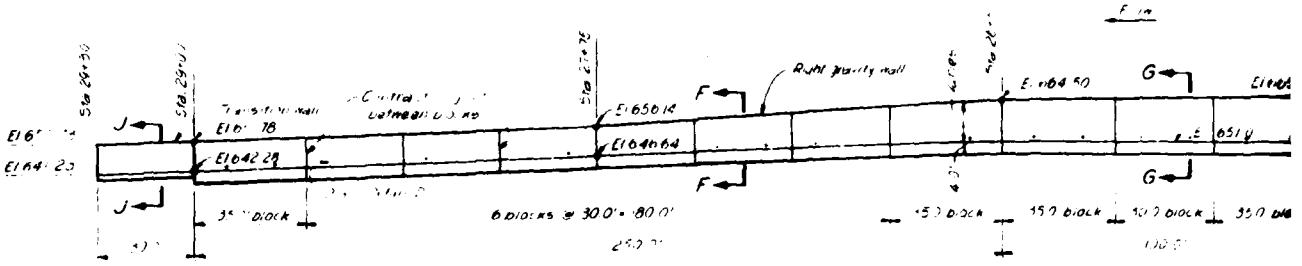


U.S. ARMY

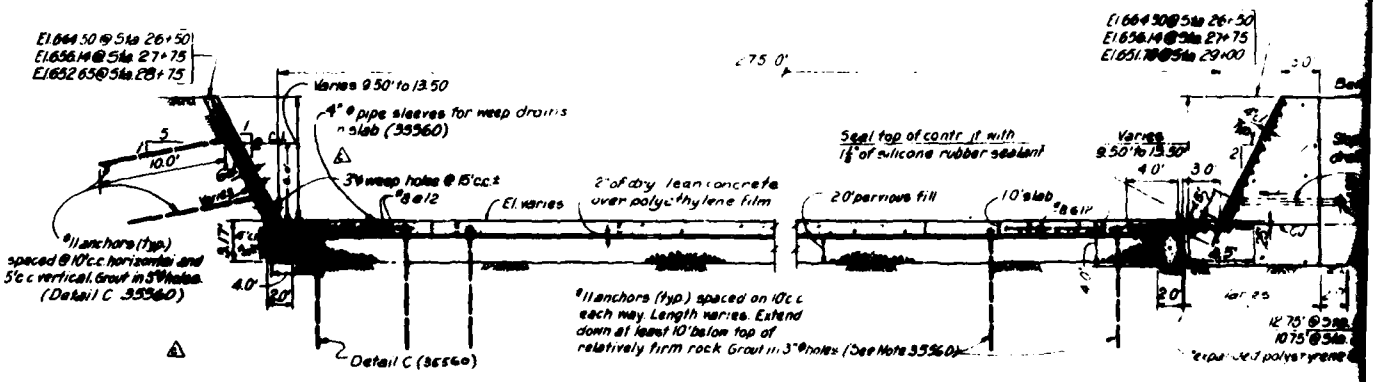
REVISIONS



CORPS OF ENGINEERS

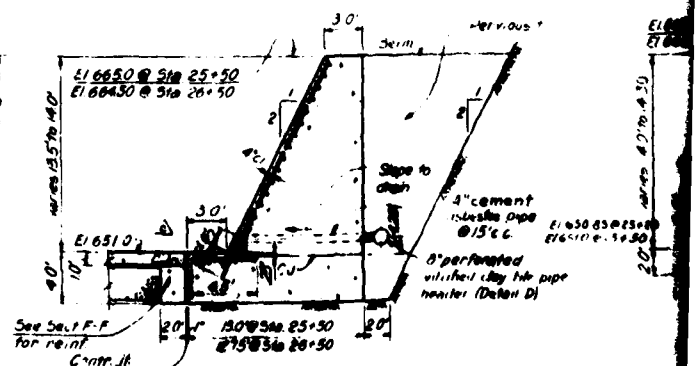



ELEVATION D-D

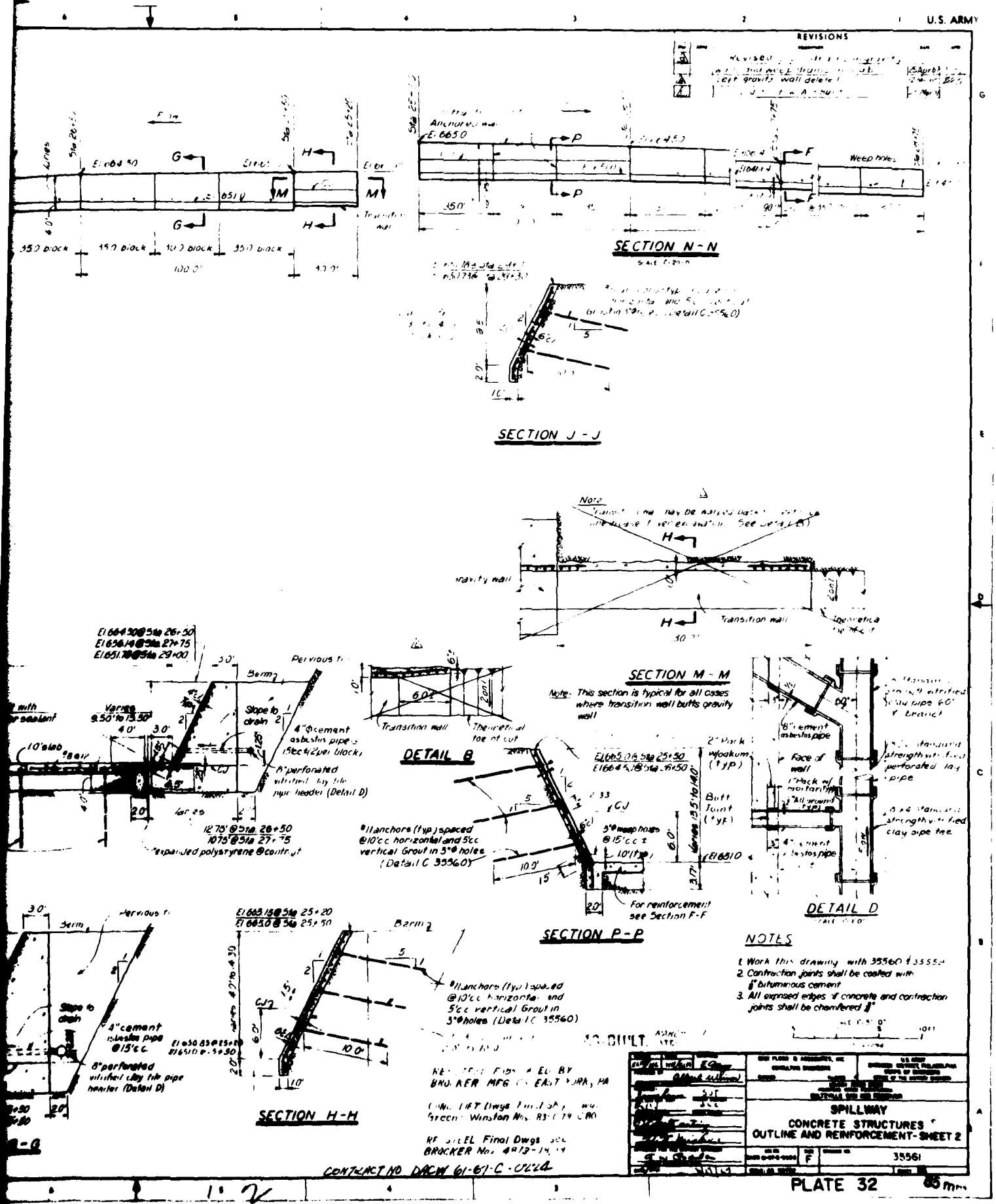


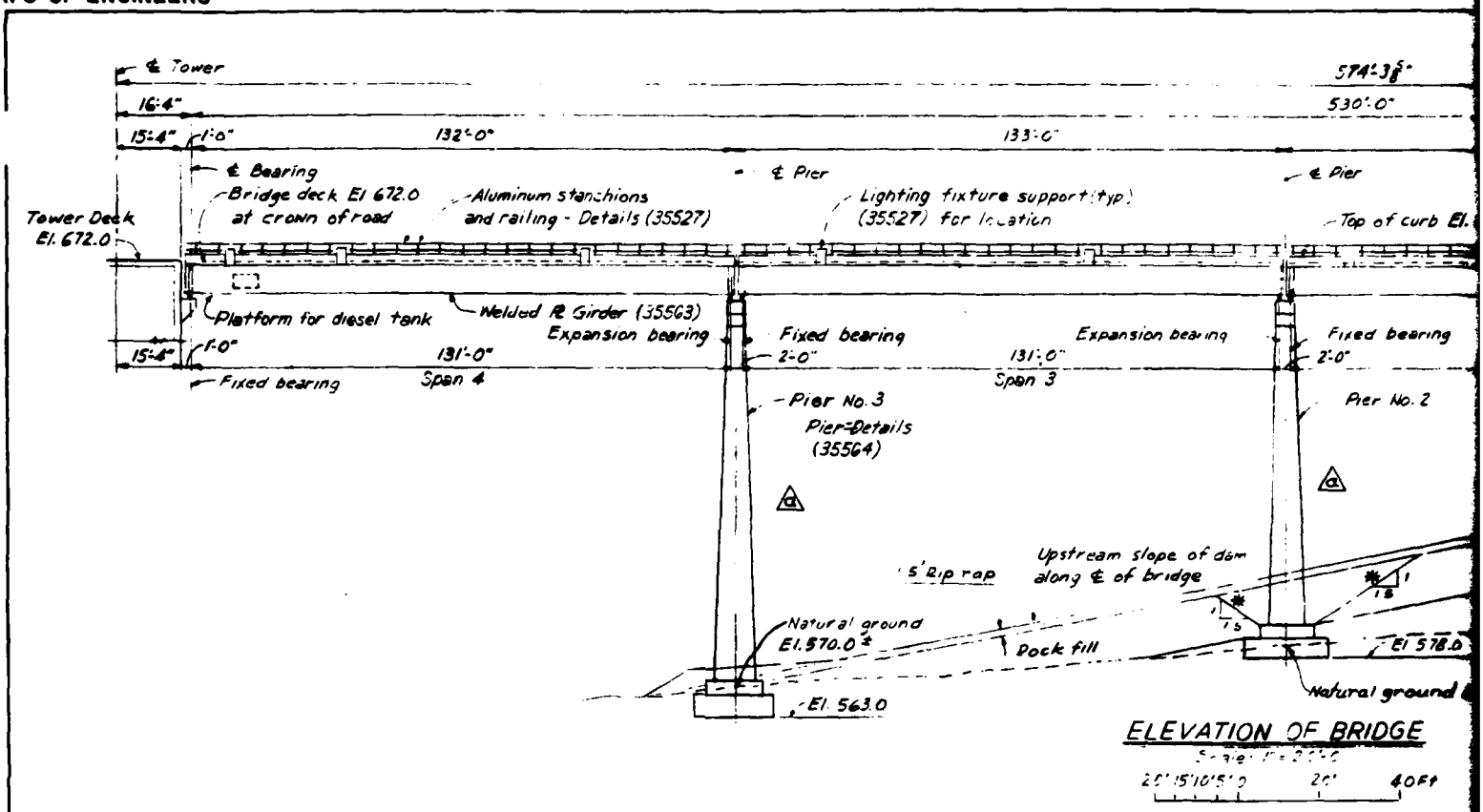

SECTION F-F

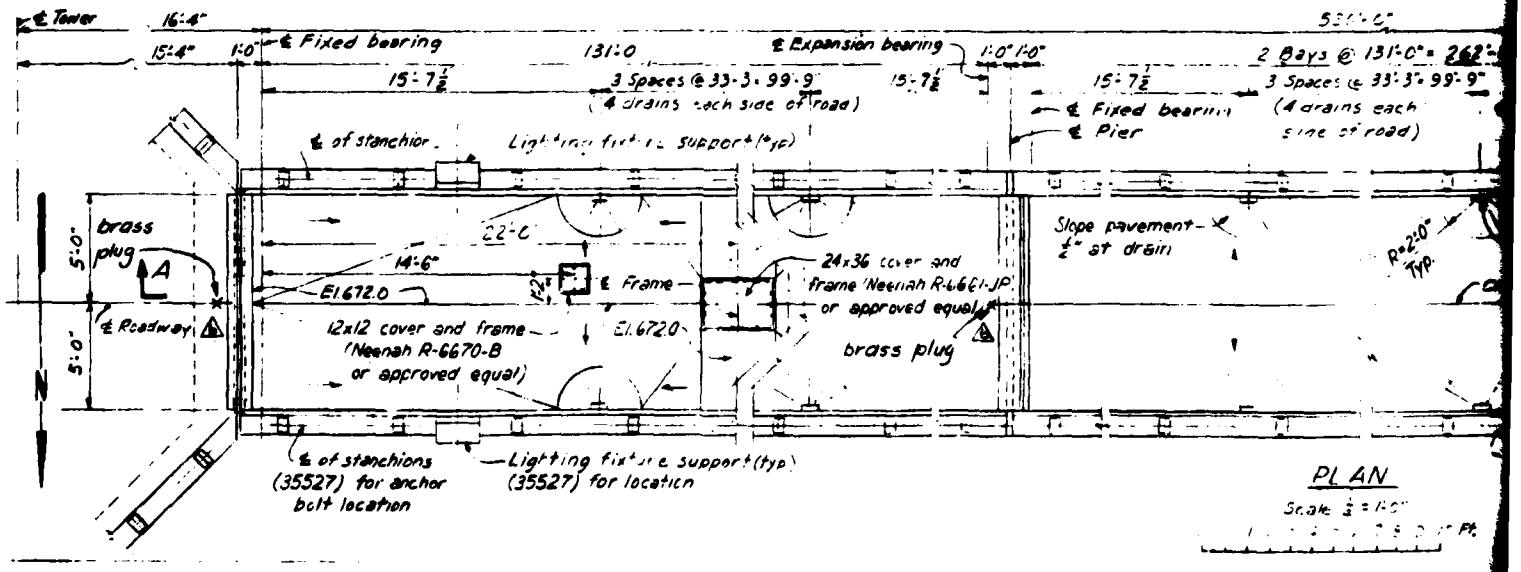

Actual Plan of Anchor Wall Southside Spwy Showing Thickness Variation

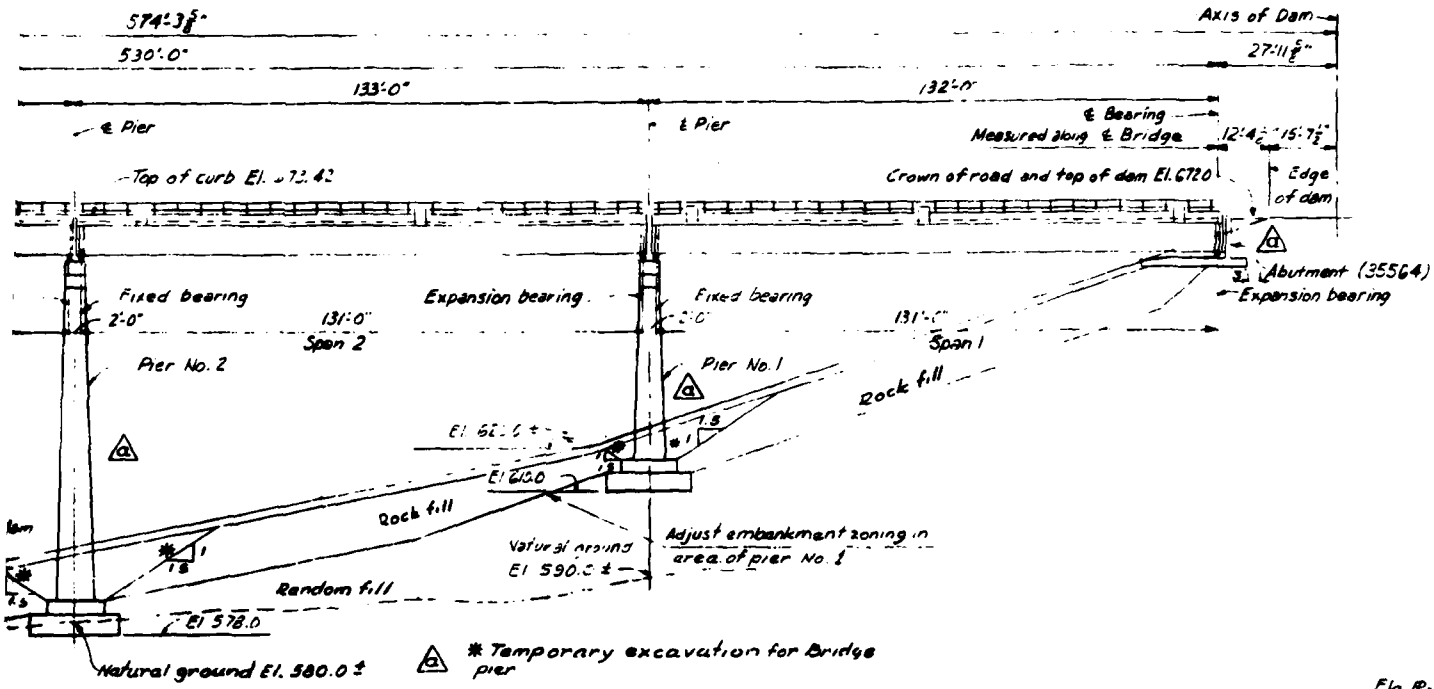



SECTION G-G


U.S. ARMY
REVISIONS
SECTION N-N
SECTION J-J
SECTION M-M
Note: This section is typical for all cases where transition wall butts gravity wall
DETAIL B
SECTION P-P
DETAIL D
SECTION H-H
NOTES
1. Work this drawing with 35560 & 35554
2. Contraction joints shall be coated with ½" bituminous cement
3. All exposed edges of concrete and contraction joints shall be chamfered ¾"
AS-BUILT
SPILLWAY
CONCRETE STRUCTURES
OUTLINE AND REINFORCEMENT-SHEET 2
35561
CONTRACT NO DACW 61-67-C-0024
PLATE 32


℄ Tower
16'-4"
15'-4"
1'-0"
132'-0"
133'-0"
530'-0"
℄ Bearing
Bridge deck El 672.0 at crown of road
Aluminum stanchions and railing - Details (35527)
℄ Pier
Lighting fixture support (typ) (35527) for location
Tower Deck El. 672.0
Top of curb El.
Platform for diesel tank
Welded ℞ Girder (35563)
Expansion bearing
Fixed bearing
2'-0"
131'-0"
Span 4
Span 3
Pier No. 3
Pier-Details (35564)
Pier No. 2
Upstream slope of dam along ℄ of bridge
Rip rap
Natural ground El. 570.0±
Dock fill
El. 563.0
El 578.0
Natural ground
ELEVATION OF BRIDGE
40 Ft

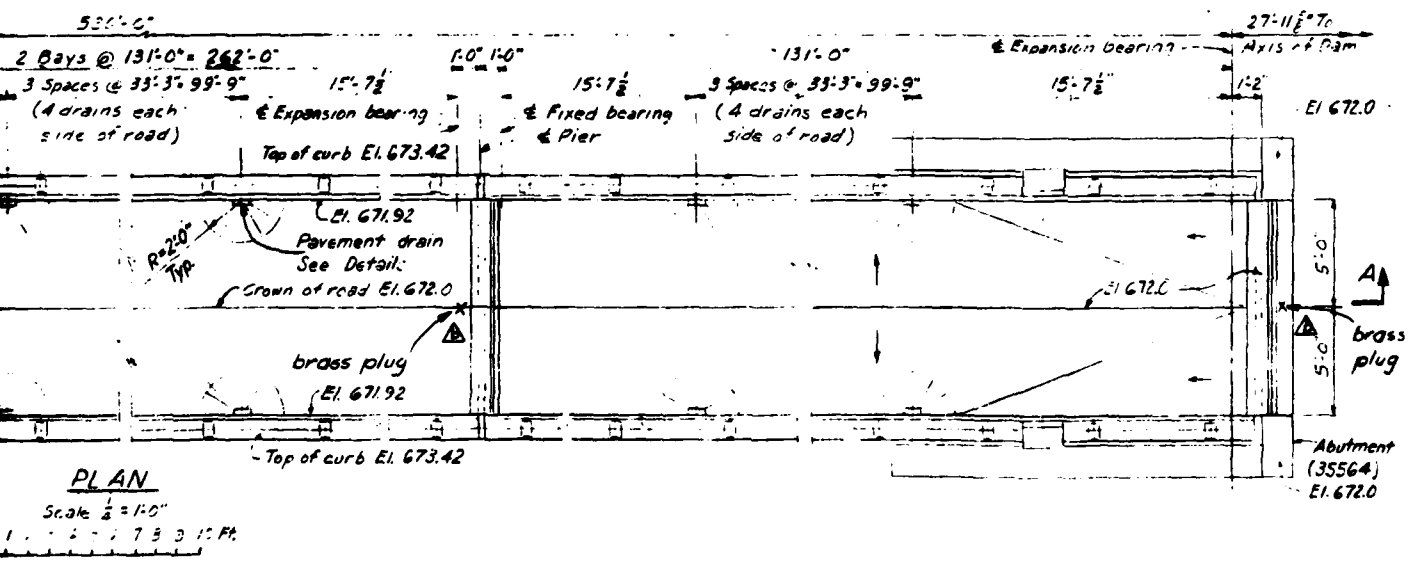

℄ Tower
16'-4"
15'-4"
1'-0"
℄ Fixed bearing
131'-0"
℄ Expansion bearing
1'-0" 1'-0"
2 Bays @ 131'-0" = 262'-
15'-7½"
3 Spaces @ 33'-3" = 99'-9"
(4 drains each side of road)
℄ Fixed bearing
℄ Pier
℄ of stanchion
Lighting fixture support (typ)
brass plug
A
5'-0"
22'-0"
14'-6"
El. 672.0
℄ Frame
24x36 cover and frame (Neenah R-6661-JP) or approved equal
Slope pavement ½" at drain
R=2'-0" Typ.
℄ Roadway
12x12 cover and frame (Neenah R-6670-B or approved equal)
brass plug
N
℄ of stanchions (35527) for anchor bolt location
Lighting fixture support (typ) (35527) for location
PLAN




TION OF BRIDGE

Scale: 1" = 20'-0"

0 20' 40 Ft

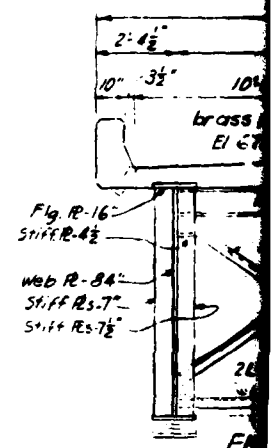



PLAN

Scale: 1/4" = 1'-0"

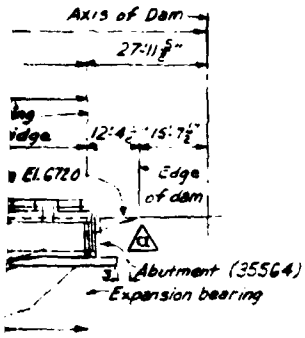
1 2 3 4 5 6 7 8 9 10 Ft

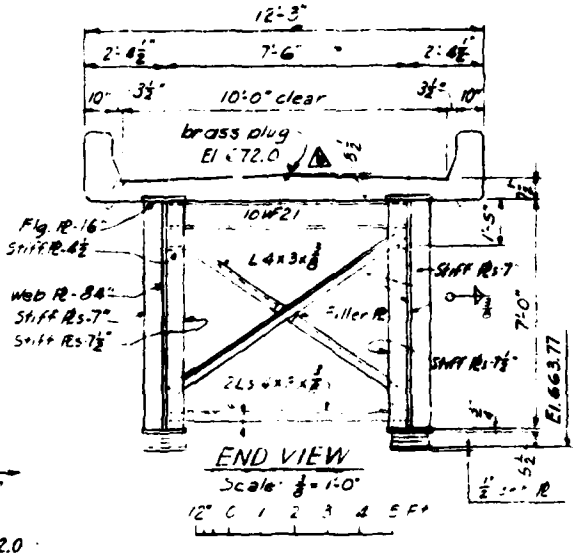
Set 1φ x 0'-2" brass plugs in non-shrink grout at elevation of deck. Scribe center line of bridge in plug after plugs are in place.

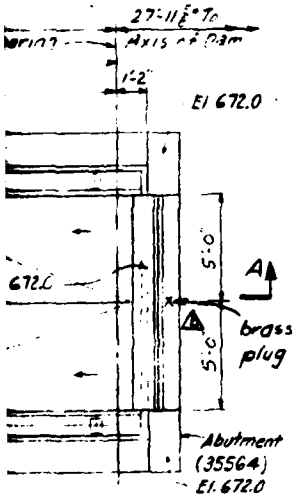


U. S. ARMY

| REVISIONS | | |
|---|---|---|
| | | Revised piers and temporary excavation |
| | | Added brass plugs for instrumentation |




grout at elevation
lug after plugs

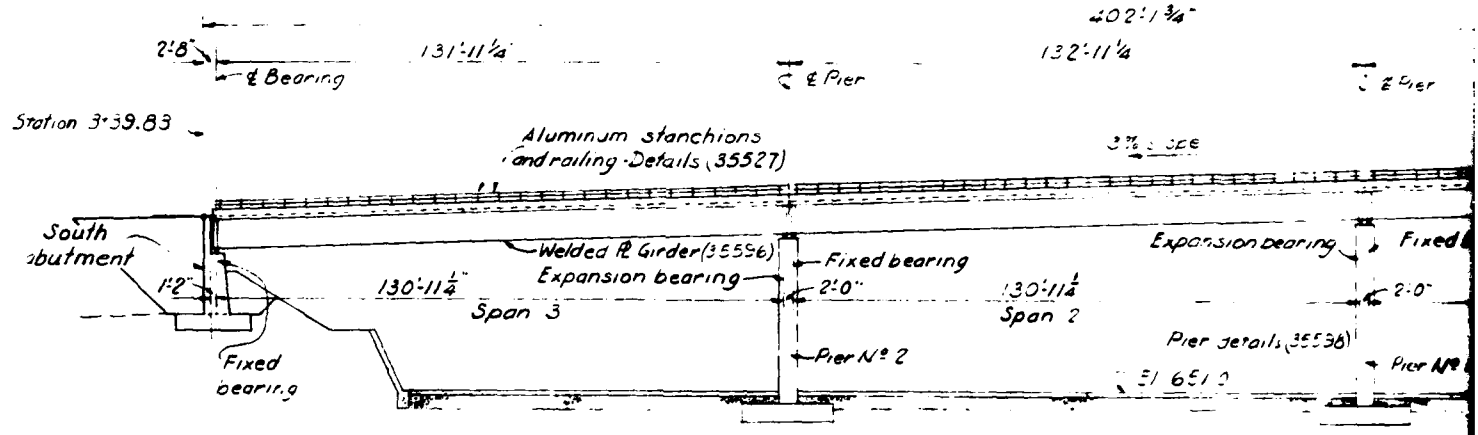
| | |
|---|---|
| ERIN FLOOD & ASSOCIATES, INC. CONSULTING ENGINEERS CHICAGO ILLINOIS | U.S. ARMY ENGINEER DISTRICT, PHILADELPHIA CORPS OF ENGINEERS OFFICE OF THE DISTRICT ENGINEER |

LEHIGH RIVER BASIN
PONOPOKO CREEK PENNSYLVANIA
BELTZVILLE LAKE

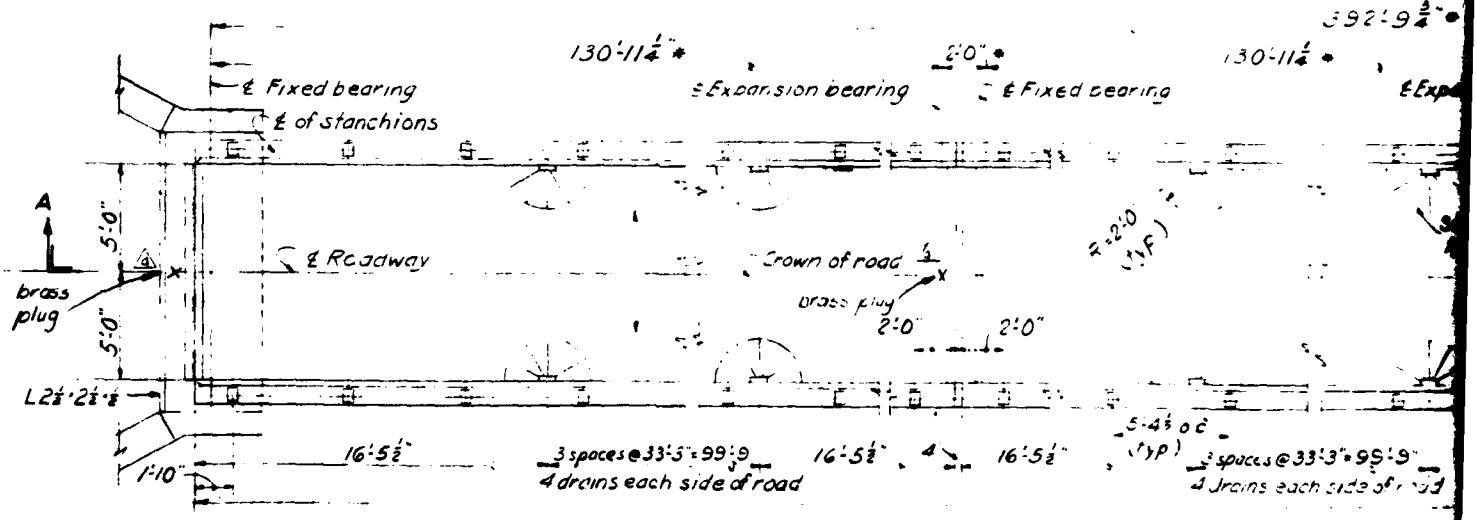
**SERVICE BRIDGE**
**ELEVATION AND STRUCTURAL DETAILS**
**SHEET 1**

| | | | |
|---|---|---|---|
| | F | | 35562 |
| SCALE: AS NOTED | | | |

PLATE 33



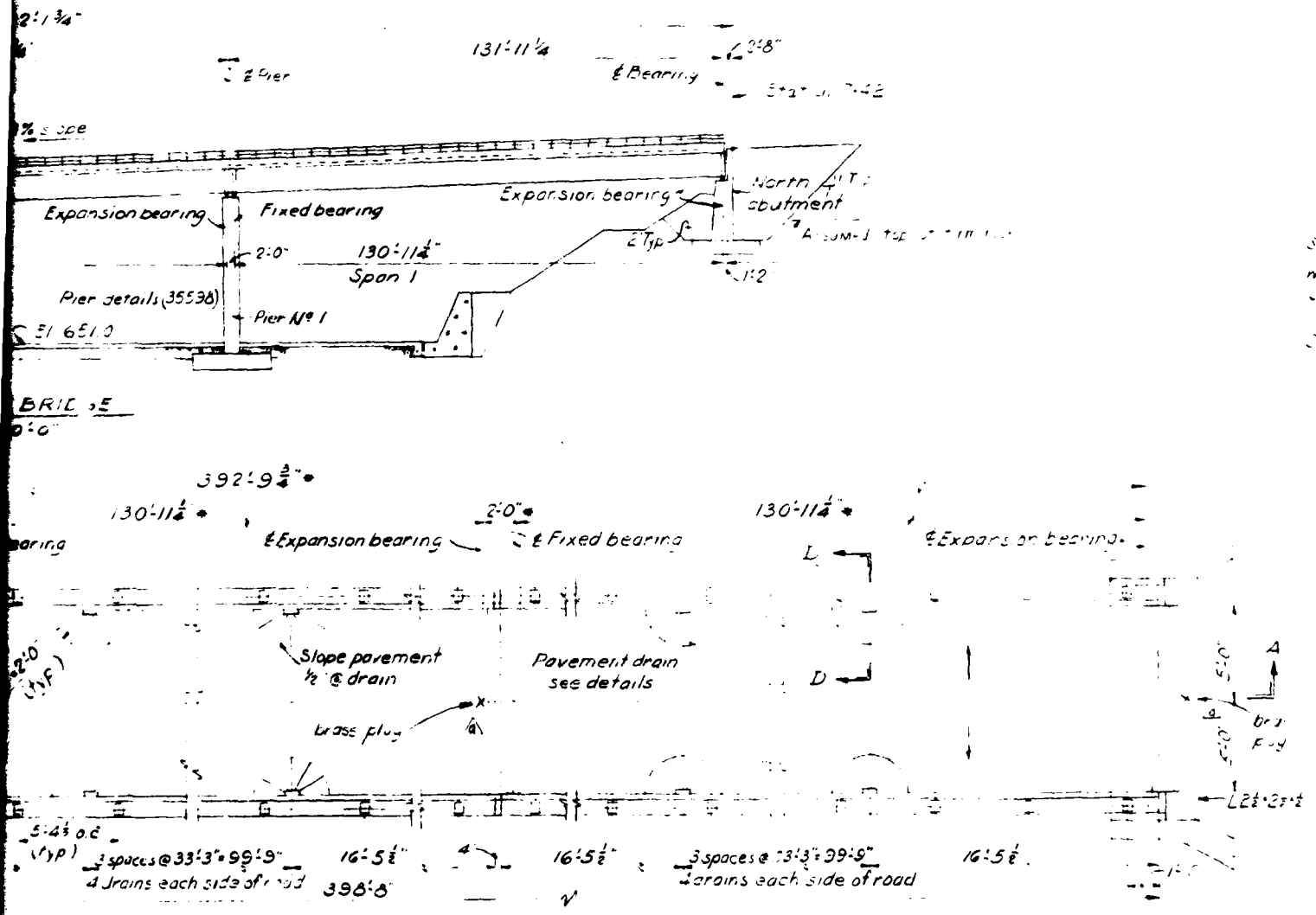

ELEVATION OF BRIDGE
Scale 1" = 20'-0"




PLAN
Scale 1/4" = 1'-0"

| Location | Top of Pier or Abut | Top of Leveling Pl |
|---|---|---|
| North Abutment | 694.74* | 694.95 |
| Pier No 1, Span No 1 | 690.78 | 691.02 |
| Pier No 1, Span No 2 | 690.78 | 690.96 |
| Pier No 2, Span No 2 | 686.79 | 687.03 |
| Pier No 2, Span No 3 | 686.79 | 686.97 |
| South Abutment | 682.83* | 683.04 |

* On ℄ of bearing




PLAN * Indicates horiz. dim.
Scale ¼" = 1'-0"

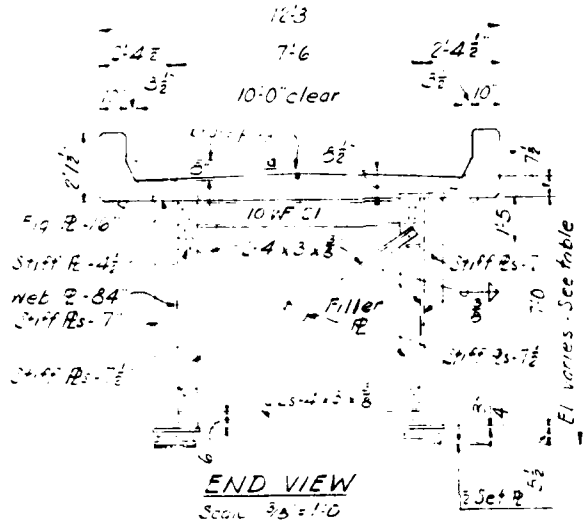
⚠ Set 1 @ 4'-0" ⌀ brass plug in non shrink grout at elevation of deck. Scribe center line of bridge in plug after bridge is in place.

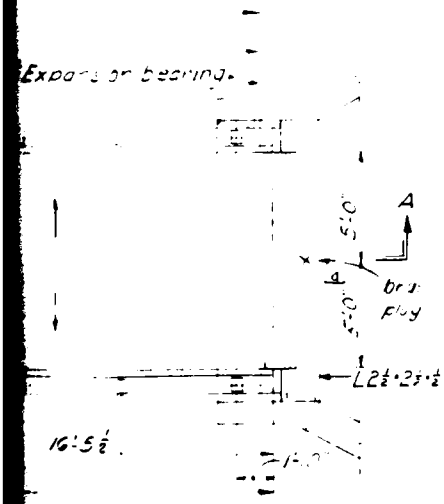
U. S. ARMY

| REVISIONS | | |
|---|---|---|
| SYM | ZONE | DESCRIPTION |
| a | | Added brass plugs for instrumentation |
| | | |

| Location | Top of Pier or Abut | Top of Leveling Pl |
|---|---|---|
| North Abutment | 694.74* | 694.95 |
| Pier No 1, Span No 1 | 690.78 | 691.02 |
| Pier No 1, Span No 2 | 690.78 | 690.96 |
| Pier No 2, Span No 2 | 686.79 | 687.03 |
| Pier No 2, Span No 3 | 686.79 | 686.97 |
| South Abutment | 682.83* | 683.04 |

* On ℄ of bearing




U. S. ARMY ENGINEER DISTRICT, PHILADELPHIA
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER

LEHIGH RIVER BASIN
POHOPOCO CREEK, PENNSYLVANIA
BELTZVILLE LAKE

**SPILLWAY BRIDGE**
**ELEVATION AND STRUCTURAL DETAILS**
**SHEET 1**

| SIZE | INV. NO. | DRAWING NO. |
|---|---|---|
| F | | 38896 |
| SCALE AS NOTED | | SHEET 121 |

PLATE 34

Appendix B

Condition Report

Beltzville Lake

Pohopoco Creek, Pennsylvania

Periodic Inspection Report No. 3 & 4

List of Attendees - Periodic Inspection Nos. 3 & 4

Beltzville Lake

List of Attendees - Periodic Inspection No. 3

| | |
|---|---|
| A. Carrabino | NAD - Engineering Division |
| A. A. Mezeika | NAD - Operations Division |
| J. T. Lewis | NAP - Engineering Division |
| M. M. Gross | NAP - Engineering Division |
| J. J. Lenahan | NAP - Engineering Division |
| E. L. Uibel | NAP - Engineering Division |
| G. A. Countryman | NAP - Operations Division |
| J. T. Borchik | NAP - Operations Division |

List of Attendees - Periodic Inspection No. 4

| | |
|---|---|
| F. C. Coppinger | NAD - Engineering Division |
| T. Thompson | NAD - Engineering Division |
| J. Smutz | NAD - Operations Division |
| A. A. Dephilippe | NAP - Engineering Division |
| R. W. Greene | NAP - Engineering Division |
| E. L. Uibel | NAP - Engineering Division |
| M. M. Gross | NAP - Engineering Division |
| H. E. Rubright | NAP - Engineering Division |
| G. A. Countryman | NAP - Operations Division |
| J. T. Borchik | NAP - Operations Division |

ATE
LMED

-8